

40

22
1988
ELEMENTS

OF

504

PATHOLOGICAL ANATOMY,

ILLUSTRATED BY

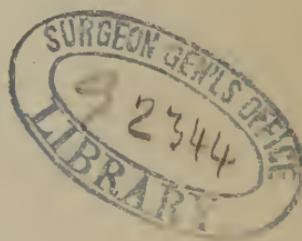
NUMEROUS ENGRAVINGS.

“IN MOREBIS, SIVE ACUTIS, SIVE CHRONICIS, VIGET OCCULTUM, PER HUMANAS
SPECULATIONES FERE INCOMPREHENSIBILE.”—BAGLIVI.

By SAMUEL D. GROSS, M. D.

LATE PROFESSOR OF GENERAL ANATOMY, PHYSIOLOGY, AND PATHOLOGICAL ANATOMY,
IN THE MEDICAL DEPARTMENT OF THE CINCINNATI COLLEGE.

IN TWO VOLUMES. VOL. I.



BOSTON:

MARSH, CAPEN, LYON, & WEBB,
AND
JAMES B. DOW.

1839.

Entered according to Act of Congress, in the year 1839, by
SAMUEL D. GROSS, M. D.

in the Clerk's Office of the District Court of the District of Massachusetts.

Q 2
G 878
1259
V. 1

WILLIAM A. HALL & CO. PRINTERS.

TO

DANIEL DRAKE, M. D.

PROFESSOR OF CLINICAL MEDICINE AND PATHOLOGICAL ANATOMY
IN THE LOUISVILLE MEDICAL INSTITUTE, ETC.

Distinguished alike as an accomplished and successful teacher, an erudite and skilful physician, a zealous promoter of science and literature, and an ardent friend of pathological anatomy, the following pages, intended to illustrate one of the fundamental branches of medical science, are respectfully inscribed, as a testimony of esteem for his exalted talents and attainments, and as a token of sincere regard for his character,

By his obliged Friend

and Servant,

THE AUTHOR.

P R E F A C E.

THE acknowledged want, in our country, of a work on pathological anatomy precludes the necessity of any apology, on the part of the author, for offering to the public the following volumes. The only native production of the kind, which has yet appeared, is the Treatise of Professor Horner, of the University of Pennsylvania, which, from the narrow limits within which it is restricted, can lay no claim to the character of a system, or be considered as exhibiting a correct view of the existing state of the science, reformed, as it has recently been, by new discoveries and improvements. As presenting a record of facts, collected with indefatigable industry, and detailed with great candor and impartiality, it is a valuable fund of information, which can never be consulted without interest and instruction.

Of foreign publications that have found their way to the United States, there are only two, those of the late Dr. Matthew Baillie, of London, and of Professor Andral, of Paris. Concerning these productions, which are both highly honorable to their authors, as well as to the nations to which they respectively belong, it need only be remarked that the one, besides being entirely out of print, is altogether in arrear of the present condition of pathological anatomy; and that the other, from the introduction of new and perplexing terms, for which there is so extraordinary a fondness on the part of the French writers, and from a singular want of systematic arrangement, can never subserve the purposes of a text-book. To supply these deficiencies, therefore, is the object of the present treatise.

It has been the constant aim of the author, in the composition of the following pages, to express himself in plain, intelligible language, to abstain from every thing like pedantry, in the use of new terms, and to furnish, as far as practicable, a comprehensive view of the existing state of the science. How far he has succeeded, in these and other respects, he leaves to the candid judgment of his reader to determine. It is sufficient to say that he has been fully sensible

of the responsibility of the enterprise, and that nearly four years have been devoted to its accomplishment.

In regard to his materials, the author may be permitted to state, that, whilst he has freely availed himself of the usual sources of information from books, as every one who wishes to present any thing like a connected view of the science necessarily must, he has not omitted, whenever occasion offered, to incorporate the results of his personal observation and experience. Although much less extensively engaged in necroscopic examinations than many of his European brethren, or even, perhaps, than some of his more immediate neighbors, his position, as Professor of Pathological Anatomy in the medical department of the Cincinnati College, has given him unusual advantages, and induced him to devote a much greater share of attention to the subject than is ordinarily allotted to it. The average period he is in the habit of spending upon such dissections is from two to three hours; and it has been his constant practice, moreover, for many years, to carry away, for subsequent and more thorough inspection, every morbid structure of interest. In this manner has been formed the nucleus of a museum of pathological anatomy, embracing already a large number of the most valuable specimens. True it is, the author has not, like Monsieur Andral, examined the thoracic duct in six hundred subjects, nor has he, like Dr. Bizot, of Geneva, performed several hundred dissections, to ascertain the relative frequency of disease in different parts of the arterial system — which is all well enough — but he has done what, in his opinion, is of much greater utility, directed particular attention to the lesions of the more important organs.

It is certainly an anomaly in the history of our profession, that a science which admits of such extensive application as the present, and which may be regarded as constituting the very foundation of the grand edifice of medicine, should still be so much neglected as a branch of elementary study in the United States. This is so much the more surprising when we consider the successful efforts which have been made, of late years, for the diffusion of general knowledge, and the absolute importance, in a pursuit like ours, of availing ourselves of every source of information, whether of a direct or collateral bearing. It displays a degree of apathy, to say the least, on the part of our schools, which is alike disreputable to them as seminaries of learning, disgraceful to the American profession, whose dignity and usefulness they ought to have at heart, and injurious to the progress of medical science.

The utility of an extended knowledge of this science cannot, indeed, be any longer a matter of doubt or dispute. Without the light which it furnishes, our views of disease must necessarily be limited and confused; whilst, by its help, the nature and seat of every lesion is comparatively easily comprehended. The history of pathological anatomy may be said, not unaptly, to be a register of observations, not of a single individual, but of many, to ascertain the

power of morbid action; and precisely in proportion as they are based on fact, is their tendency to advance the healing art to the rank and dignity of a certain science. From the successful manner in which they have been conducted within the last twenty years, and from the immense flood of light which they have shed upon the nature, seat, and diagnosis of disease, it is obvious that they alone can yield any substantial trophies; and they should therefore at once serve to guide and encourage our future researches. To discriminate between different lesions; to be able to locate, or give them "a habitation and a name;" to know the nature of their products and their effects,—these are some of the qualities which distinguish the medical philosopher from the routine practitioner, the scientific physician from the mere symptomatologist.

It is certainly a matter of deep regret that the investigation of diseased structure was not conducted in a more diligent and enlightened manner by our medical ancestors: had this been done, comparatively little would have remained to be accomplished by the present race of physicians: diagnosis, the grand object of our preparatory studies, would be much more perfect, and the fundamental principles of our profession repose upon a more firm and immutable basis. But, as it is, our heritage unfortunately amounts to little else than a detail of individual facts, drawn up, for the most part, in so loose and slovenly a manner, as to render it difficult, if not impossible, to derive from them any profitable results.

The appearance of Bichat, towards the close of the last century, on the great theatre of active life, constitutes a new epoch in the history of medicine, pregnant with the most important events. From the thorough revolution which has been effected by his writings, in the total subversion of the various artificial systems of nosology which flourished up to the period adverted to, we may justly award to him the honorable and well-merited title of the "father of modern pathological anatomy;" and to his influence and example, more than to those of any other individual or sect in medicine, are unquestionably to be ascribed all the discoveries and improvements which have been achieved, in different quarters of the civilized world, since the time in which he wrote. The admirable works of his countrymen, Laennec, Bayle, and Corvisart; Broussais, Louis, Andral, and Cruveilhier; of J. F. Meckel, of Germany, of Abercrombie, of Scotland, and of Hope, Mayo, and Carswell, of England, are all traceable, directly or indirectly, to the extraordinary impulse transmitted by this illustrious man: they are enterprises of the highest utility to medicine, and afford a happy illustration of the spirit of inquiry and philosophy which actuates the physicians of the age in which we live.

But to return from this digression. It will be perceived that considerable space is occupied with discussions relative to the normal characters of the various organs and tissues of the body. Disquisitions of this sort, though they trench upon another but kindred

department, are indispensable to a clear and intelligible comprehension of the fundamental principles of pathological anatomy. Without a knowledge of the natural color, weight, volume, and consistence of a structure, how is it possible to obtain distinct conceptions of the numerous and diversified alterations induced in it by disease? The thing is utterly impossible. Without, therefore, a competent share of information of this kind, it is obvious that no physician, whatever may be the extent of his attainments in other respects, can successfully execute the duties of a pathological anatomist. So numerous, indeed, are the sources of fallacy and deception, that even the most enlightened members of the profession frequently commit the most egregious errors, assuming for morbid what is perfectly normal, or, conversely, for healthy what is diseased, or the result solely and exclusively of cadaveric mutations. Misconceptions such as these, abstractly considered, are of no great moment; but, when principles are deduced from them, as is most generally the case, and applied to practice, their mischievous tendency becomes too obvious to require any comment in this place. The same remarks are equally true of hasty and superficial examinations, which can never be productive of any good, but, on the contrary, often lead to a great deal of harm. These are topics upon which the author would not dwell, were he not fully convinced, from daily observation, of their injurious effects upon the practice of medicine and surgery. They lie at the very foundation of the discordant statements which disfigure so many of the treatises of the present day, and which are annually inculcated, with so much zeal and eloquence, in the lecture-rooms of the Western continent.

The embarrassments which the author has had to contend with, in the execution of this branch of his subject, can only be appreciated by those who are acquainted with the meagre and contradictory statements which are to be found in our various treatises on general and descriptive anatomy. Confident, from an attentive perusal, that no satisfactory account could be gleaned from these sources, relative to the dimensions, weight, and physical properties of the different viscera, the author has been induced, in most instances, to substitute the results of his own observations, in preference to what, in his opinion, appeared to be information of equivocal authenticity. Although his examinations of individual parts have not been so numerous as could be desired, yet he ventures to predict, from the rectitude with which they were conducted, that future researches will not essentially contradict them. It would be well if a standard of comparison could be established, by which to judge of the normal character of every organ in the body; but, to be complete, it is obvious that it must be constructed in reference to the varying circumstances of age, sex, and stature. Until this be accomplished, our statements must necessarily be devoid of that precision which is so indispensable in all pathological investigations. Nor can a standard of this sort be determined by a single individual: to be

worthy of implicit confidence, and susceptible of general application, it must be the joint labor of numerous inquirers in different parts of the world.

Some apology may be thought necessary for the manner in which the author has expressed himself in relation to the subject of inflammation. Disclaiming to be the follower of any man, or school, in medicine, the sentiments he has avowed are the results of his conscientious conviction, grounded upon personal observation and reflection; and, as such, he does not hesitate to submit them to the scientific scrutiny of his professional brethren. Those who have been in the habit of contemplating disease, as revealed by the phenomena of the living system, and by the knife after dissolution, will agree with him, at least, that, if disease be not, like life itself, a unit, it has few elements, and that these elements are so modified by internal and extrinsic causes, or, in other and more appropriate terms, by texture, age, sex, constitution, climate, season, and other circumstances, as to produce those multiform features which are a source of so much difficulty and perplexity to the nosological physician.

In every science some system is required; and in no one is this more necessary than in pathological anatomy. The most natural arrangement that suggests itself is that unquestionably which relates to the affinities existing between the different structures; but, however desirable it might be in some respects, it is evidently not sufficiently specific, and has therefore not been adopted in the present work. After presenting an account of the general principles of the science, the author proceeds to consider the lesions of each organ and tissue individually, indicating their anatomical characters, and also, as far as they are known, their diagnostic signs. In thus treating the subject, although some repetition is unavoidable, yet much greater order is attained, as well as wider scope afforded for minute discussion, than by the adoption of any other classification. How far the attempt to blend the description of diseased action with the study of pathognomonic symptoms, which is, in great degree, peculiar to the work, will meet the sanction of the profession, time alone can determine. Without being altogether unobjectionable, it has a direct tendency to augment the utility of pathological science, by pointing out its true connection, and cannot fail, therefore, if properly carried out, to be of the greatest practical benefit to the physician.

The drawings illustrative of the heterologous formations, and of the lesions of the gastro-enteric mucous membrane, are from the pencil of Mr. Henry Brown, a young artist of uncommon merit. They are, with few exceptions, taken from nature, and their accuracy is such as to entitle them, in all respects, to the confidence of the reader. Of the wood cuts, some are original, but the greater part are collected from other sources, with no little trouble and expense.

Before bringing these prefatory remarks to a close, the author would tender his sincere acknowledgments to Dr. J. Wyman, of Boston, who kindly offered his aid in bringing this work before the public, taking upon himself the labor of superintending the passage of the sheets through the press.

Finally, the author is not without the hope that the present treatise, imperfect as it is, will contribute, in some degree, towards the abolition of ancient errors, extend the boundaries of useful knowledge, and diffuse a taste for the cultivation of pathological anatomy.

Cincinnati College, July 1, 1839.

CONTENTS.

PART I.

GENERAL PRINCIPLES OF PATHOLOGICAL ANATOMY.

CHAPTER I.

OF INFLAMMATION.

Preliminary Observations.— Fluids and Solids.— Different kinds of Sympathy.— Disease, functional and organic.— Inflammation, how modified by Temperament, Age, Sex, Habit, Climate, Season, the nature of the exciting cause, and the character of the Tissue; acute and chronic; does not occur with equal frequency in all parts of the body; common and specific.— Nature, Symptoms, and Seat of ordinary Inflammation; Redness, Heat, Pain, and Swelling; Derangement of the Vital Actions; Structure of the Capillaries; joint agency of the Vascular and Nervous Systems; altered Sensibility; preternatural influx of Blood; Experiments and Opinions of Kaltenbrunner.— Congestion; Theories of Boerhaave, Cullen, Vacca, and others.— Terminations and Conditions of Inflammation, - - - - 19

CHAPTER II.

OF THE EFFUSION OF SERUM.

Occurs to a greater or less extent in almost every Inflammation.— Cœdema, Anasarca, and Dropsy.— Color, Consistence, Quantity, and chemical Composition.— Usually the result of a mild degree of Inflammation.— Conclusion, - - - - - 53

CHAPTER III.

OF LYMPHIZATION.

Always the result of Inflammation.— Physical properties of Lymph.— Quantity.— Varieties of Form.— Chemical Constitution.— Period at which the Deposition commences.— Has a tendency to become organized.— How this is effected.— Analogous Tissues.— Use of Lymph as a means of Restoration.— Adhesive Action, - - - - - 59

CHAPTER IV.

OF SUPPURATION.

Definition.— Organs in which it is most easily effected.— May take place without Solution of Continuity.— Varieties of Form.— Abscesses.— Physical and Chemical Properties of Pus.— Distinguishing Tests.— How produced, - - - - - 69

CHAPTER V.

OF HEMORRHAGE.

The subject still involved in obscurity.—Causes.—Opinions of Morgagni and of Bichat.—Exhalant Vessels.—Aptitude of different Structures.—Nomenclature.—Predisposition.—Hereditary Proclivity.—Hemorrhage sometimes vicarious.—Active and passive.—Critical.—Quantity of Blood effused.—Changes and final Disposition, - - - - -	76
---	----

CHAPTER VI.

OF SOFTENING.

One of the most unequivocal signs of Inflammation.—Structures most liable to be affected by it.—In what anatomical Element is the Lesion seated?—Causes.—Opinions of Rostan and other writers.—Degrees of Softening, - - - - -	84
--	----

CHAPTER VII.

OF GANGRENE.

Definition.—Parts most apt to suffer.—Color and Consistence.—Extent.—Manner in which Nature guards against the occurrence of Hemorrhage.—Causes, of two kinds.—Malignant Pustule.—Gangrene from the use of Ergot.—From the exhibition of Tartar Emetic.—Senile Gangrene, - - - - -	87
--	----

CHAPTER VIII.

OF ULCERATION.

Definition; intricate nature.—Most common in the Skin, Cellular Tissue, and Mucous Membranes.—May be slow or rapid.—Manifests a tendency to extend towards the nearest surface.—Produced by Inflammation.—Ulcers sometimes heal; the process by which this is accomplished.—Ulceration a sanative effort, - - - - -	96
---	----

CHAPTER IX.

OF GRANULATION.

Importance of the Subject.—Nature of Granulations.—Difference in regard to their Vascularity and Sensibility.—How modified by Texture.—Are secreting and absorbing Organs, - - - - -	100
--	-----

CHAPTER X.

OF CICATRIZATION.

Nature of the Process.—Different Steps.—Do Ulcers ever heal from the Centre?—Process of Cicatrization influenced by the Form and Situation of the Sore.—Meaning of the term Cicatrice.—Reproduction of the original Tissues, - - - - -	103
--	-----

CHAPTER XI.

OF INDURATION.

Definition.—Historical Notice.—Color, Size, and Degree.—Period necessary for its Production.—Causes, - - - - -	106
--	-----

CHAPTER XII.

OF HYPERTROPHY.

Meaning of the Term.—Liabilities of different Structures.—Causes.—May be general or local.—Color, Weight, and Volume, of the Part affected, - - - - -	111
---	-----

CHAPTER XIII.

OF ATROPHY.

Definition. — May be general or partial. — Causes: want of Exercise; diminution of the Nervous Influence; deficient supply of Blood, - - - - 116

CHAPTER XIV.

OF TRANSFORMATIONS.

The Body in a state of constant Mutation. — Number of Transformations: the Cellular, Mucous, Cutaneous, Fibrous, Cartilaginous, Osseous and Adipous, - - - - - 121

CHAPTER XV.

OF HYDATIDS.

Historical Outline. — Where found. — Classification of Hydatids. — The Cysticercus, Polycephalus, Diceras, Echinococcus, and Acephalocystis. — Their Origin and Organization. — The manner in which they are nourished. — The Changes which they experience by Age, and the Alterations they induce in the Organs in which they are developed, - - - - - 131

CHAPTER XVI.

OF SEROUS CYSTS.

Have the form of shut Sacs. — Organs in which they are most frequently found. — Classification: the simple, multilocular, and the included. — Nature of the contained Fluid. — Are either new products, or formed out of the pre-existing Textures. — Are liable to Inflammation and its consequences, - - - - - 143

CHAPTER XVII.

OF THE HETEROLOGOUS FORMATIONS.

Preliminary Observations. — Classification: Tubercl; Melanosis; Scirrh; Encephaloid. SECTION I. *Tubercl*. — Definition. — Great frequency. — Occurs nearly in all Tissues, and at all Periods of Life. — Is common in the lower Animals. — Chemical Composition. — Varieties of Form. — Concrete and semi-concrete Tubercl Matter. — Notions respecting its Origin, Developement, and Organization. — Softening and Excavations. SECTION II. *Melanosis*. — Historical Sketch. — Occurs in Man and Animals. — Chemical Analysis. — Color and Consistence. — Varieties of Form. — Tissues most liable to suffer from Melanotic Diathesis. — States of the System which predispose to its formation. SECTION III. *Scirrh*. — Difficulty of the Subject. — Definition. — Varieties of Form. — Chemical Constitution. — Rarely appears before the age of thirty. — Most common in Glandular Organs. — Proximate Cause. — Opinions of Adams, Carmichael, Hodgkin, and others. — Is apt to Ulcerate and involve the general System. SECTION IV. *Encephaloid*. — Is intimately allied to Scirrh. — Terms by which it has been designated. — More frequent in some Structures than in others. — Varieties of Form. — Color, Consistence, and Composition. — Organization and Mode of Origin. — A Disease of early Life. — Involves the whole System. — Termination, - - - - - 148

PART II.

SPECIAL PATHOLOGICAL ANATOMY.

CHAPTER I.

OF THE BLOOD.

Physical Properties.—Chemical Analysis.—Division into Serum, Fibrin, and Hematosine.—Lesions of the Blood.—Nature and Formation of the buffy Coat.—Cupped appearance of the Blood.—Want of Coagulability.—Relative quantity of Fibrin in healthy and diseased Blood.—Alterations of the Hematosine.—Lesions of the Serum, in Inflammation, Dropsy, and other Maladies.—Changes of the Blood, from acceleration of the Circulation and Division of the Pneumo-gastric Nerves.—Appearances in Cholera, Fever, Chlorosis, and Scurvy, - - - - - 197

CHAPTER II.

OF THE CELLULAR TEXTURE.

Distribution.—Physical Characters.—Organization.—Physiological Properties.—Lesions.—Acute Inflammation.—Suppuration.—Gangrene.—Chronic Inflammation.—Induration.—Serous Infiltration.—Emphysema.—Degenerations.—Foreign Substances.—Guinea Worm, - - - - - 228

CHAPTER III.

OF THE ADIPOUS TEXTURE.

Organization.—Exists only in particular regions of the Body.—Office of the Adipous Vesicles.—Nature and Uses of the Fat.—Lesions of the Adipous Tissue.—Wounds.—Liability to Inflammation.—Hypertrophy, general and local.—Adipous Diathesis.—Atrophy, - - - - - 239

CHAPTER IV.

OF THE MUSCULAR SYSTEM.

SECTION I. *Of the Muscles.*—Different Classes.—Structure.—Color and Consistence.—Chemical Analysis.—Sensibility.—Reunite when divided.—Inflammation.—Suppuration.—Mortification.—Chronic Irritation.—Softening.—Induration.—Ossification.—Fibrous and Fatty Transformations.—Heterologous Deposits.—Hypertrophy.—Atrophy.—Parasitic Animals.—Sanguineous Effusions. SECTION II. *The Tendons.*—Appearance and Organization.—Reunite when divided.—Inflammation.—Ossification.—Atrophy.—Diseases of the Sheaths of the Tendons. SECTION III. *The Aponevroses.*—Structure.—Acute and Chronic Inflammation.—SECTION IV. *The Synovial Bursa.*—Situation and Structure.—Are liable to Disease.—Fibro-cartilaginous Concretions.—Hypertrophy.—Hydrocephalous, - - - - - 247

CHAPTER V.

OF THE ARTERIES.

Their Tunics.—Nutrict Vessels.—Nerves.—Cellular Sheath.—Lesions.—Wounds.—Inflammation.—Suppuration.—Ulceration.—Aneurism.—Contraction.—Hypertrophy.—Morbid Deposits, - - - - - 271

CHAPTER VI.

OF THE VEINS.

More numerous and capacious than the Arteries.—Tunics and Valves proper Vessels and Nerves.—Lesions.—Acute Inflammation.—Suppu-

ration. — Ulceration. — Chronic Inflammation. — Dilatation. — Obliteration. — Calcareous Deposits. — Phlebolites. — Admission of Air, - - - 291

CHAPTER VII.

OF THE LYMPHATICS.

Organization. — Liability to Inflammation and Suppuration. — Tubercular Deposits. — Dilatation. — Aneurism of the Thoracic Duct. — Situation and Structure of the Lymphatic Ganglions. — Lesions. — Inflammation and its ordinary consequences. — Hypertrophy. — Encephaloid Disease. — Tubercl. — Ossification. — Melanosis, - - - - - 301

CHAPTER VIII.

OF THE JOINTS.

SECTION I. *The Articular Cartilages.* — Structure and Chemical Composition. — Vascularity. — Lesions. — Reparation. — Inflammation. — Softening. — Suppuration. — Ulceration. — Ossification. SECTION II. *The Synovial Membranes.* — Organization, Appearance, and Office. — Diseases: Inflammation — Effusion of Lymph and Pus — Ulceration — Chronic Irritation — Loose Cartilages — Chalky Concretions. SECTION III. *The Ligaments.* — Structure and Sensibility. — Adhesive Inflammation. — Atrophy. — Calcareous Concretions, - - - - - 311

CHAPTER IX.

OF THE OSSEOUS SYSTEM.

SECTION I. *The Bones.* — Notions of the older Writers respecting their Organization. — Vessels and Nerves. — Chemical Constitution. — Effects of Heat and Acids. — Classification. — Compact, Areolar, and Canalicular Textures. — Diseases of the Bones. — Reparation. — Inflammation. — Suppuration. — Ulceration. — Gangrene. — Softening. — Fragility. — Hypertrophy. — Atrophy. — Hydatids. — Aneurism. — Carcinoma. — Melanosis. — Tubercl. SECTION II. *The Periosteum.* — Its fibrous structure liable to the same kinds of Diseases as the fibrous Membranes generally. — Hypertrophy. — Ossification. — Is seldom, if ever, affected by the Heterologous Formations. SECTION III. *The Medullary Membrane.* — Situation and Character. — Diseases few, but important, - - - - - 324

CHAPTER X.

OF THE CUTANEOUS SYSTEM.

SECTION I. *The Skin.* — Number of Layers. — Epidermis. — Mucous Web. — Dermis. — Papillæ. — Sudoriferous Glands. — Sebaceous Follicles. — Reproductive power of the different lamellæ of the Skin. — Diseases. — (I.) Unclassifiable Lesions. — Keloid. — Melanosis. — Encephaloid. — Cartilaginous Tumors. — Eiold. — Lepoid. — Hypertrophy. — Corns. — Warts. — Horny Excrescences. — Gangrene. — Sebaceous Tumors. — Hemorrhages. — (II.) Classifiable Lesions. 1. Exanthematous Diseases. — 2. Pustular. — 3. Papular. — 4. Bullar. — 5. Tubercl. — 6. Scaly. — 7. Syphilitic Diseases. — 8. Stains. SECTION II. *The Nails.* — Situation, Composition, and Arrangement. — Growth. — Reproductive Power. — Inordinate Length. — Absence. — Malformation. — Vicious Situation. — Onyxitis. SECTION III. *The Hairs.* — Similarity to the Nails. — Situation. — Consist each of a Follicle and Stem. — Organization. — Polish Plait. — Regenerating Power. — Hypertrophy. — Female Beards. — Softening. — Fragility. — Changes of Color. — Accidental development of Hair, - - 355

CHAPTER XI.

OF THE NERVOUS SYSTEM.

SECTION I. *General Observations.* — Cerebral Envelopes. — Cephalo-spinal Liquid. — White and Gray Substances. — Chemical Composition. — Con-

sistence. — Color. — Sensibility. — Vascularity. — Absorbent Vessels. — Speculations of Kellie and Abercrombie, respecting the Compressibility of the Cerebral Tissue. — Weight of the Encephalon and Form of the Spinal Cord. SECTION II. *Lesions of the Cerebral Envelopes.* — Inflammation of the Dura Mater. — Suppuration. — Fibrous Tumors. — Bony Deposits. — Hypertrophy of the Glands of Pacchioni. — Arachnitis. — Hydrocephalus. — Tubercles. — Stages and Symptoms of Arachnitis. — Diseases of the Pia Mater. SECTION III. *Lesions of the Brain.* — Wounds. — Encephalitis. — Suppuration. — Abscesses. — Gangrene. — Softening. — Chronic Inflammation. — Induration. — Ulceration. — Sanguineous Effusions. — Tubercles. — Melanosis. — Encephaloid. — Cartilaginous Formations. — Calcareous Deposits. — Cysts and Hydatids. — Hypertrophy and Atrophy. — SECTION IV. *Lesions of the Spinal Cord.* — Inflammation. — Heterologous Formations. — Hydro-rachitis. SECTION V. *Lesions of the Nerves.* — Classification. — Form. — Distribution. — Connection and Structure. — Restorative Power. — Neuritis. — Suppuration. — Ulceration. — Hypertrophy and Atrophy. — Diseases of the Nervous Ganglia, - - - - - 419

CHAPTER XII.

OF THE EYE.

SECTION I. *Lesions of the Lacrymal Apparatus.* — Preliminary Observations. — Lacrymal Gland. — Ducts and Sac. SECTION II. *Lesions of the Ball of the Eye.* — The Conjunctiva. — Pterygium. — Lacrymal Caruncle. — Acute Corneitis. — Ulceration and Ossification of the Cornea. — Fleshy Excrencences. — Alterations of Form. — Diseases of the Sclerotica. — Choroid Tunic. — The Retina. — Amaurosis. — Optic Nerve. — Membrane of Demours. — Hæmophthalmus. — Lesions of the Iris. — Alterations of the Pupil. — Capsule of the Crystalline Lens. — Liquor of Morgagni. — Varieties of Cataract. — Vitreous Humor. — Heterologous Formations, - - - 485

CHAPTER XIII.

OF THE EAR.

Preliminary Remarks. — Malformations of the external Ear. — Polypous Growths. — Lesions of the Tympanum. — Bones of the Ear. — Eustachian Tube. — The Labyrinth and Vestibule. — Diseases of the Auditory Nerve, - - - - - 512

P A R T I.

GENERAL PRINCIPLES

OF

PATHOLOGICAL ANATOMY.

PATHOLOGICAL ANATOMY.

CHAPTER I.

Of Inflammation.

Preliminary Observations.—Fluids and Solids.—Different kinds of Sympathy.—Disease, functional and organic.—Inflammation, how modified by Temperament, Age, Sex, Habit, Climate, Season, the nature of the exciting cause, and the character of the Tissue; acute and chronic; does not occur with equal frequency in all parts of the body; common and specific.—Nature, Symptoms, and Seat of ordinary Inflammation; Redness, Heat, Pain, and Swelling; Derangement of the Vital Actions; Structure of the Capillaries; joint agency of the Vascular and Nervous Systems; altered Sensibility; preternatural influx of Blood; Experiments and Opinions of Kaltenbrunner.—Congestion; Theories of Boerhaave, Cullen, Vacca, and others.—Terminations and Conditions of Inflammation.

THE human body is composed of solids and fluids, which are intimately blended together, and mutually dependent upon each other for their origin and preservation. Both classes are resolvable into a number of proximate constituents, differing widely in their color, their consistence, and their chemical properties. Of the fluids, the blood is by far the most important, as it is out of it that the solids are formed, and by it that they are nourished and sustained. The quantity of this liquid, on an average, is about eighteen pounds; but it may be observed that it is liable to vary not only in different persons, but likewise in the same individuals at different periods. Not only its amount, but also its quality, is much influenced by the kind of food and drink, the exercise, the climate, and mode of life to which the individual is subjected. It is not my design, in this place, to say any thing of the chemical constituents of the blood, further than to declare that this fluid contains all the elements of the solid parts of the body, that the latter are constantly permeated by it, and that there can be no secretion, whether healthy or morbid, that is not derived from it. The diseases to which it is liable will be made the subject of separate consideration.

The solids consist of what have been called, since the time of Bichat, the tissues; of which the number has been variously stated by different writers, scarcely any two agreeing on the subject. Without occupying the attention of the reader with any discussion of this sort, which would be out of place here, I shall merely remark concerning them, that they all differ from each other in their appearance, their composition, their structure, and the purposes which they are designed to fulfil in the economy. With the exception of the muscular and nervous fibres, they all seem to be derived from the cellular element, — a substance which enters so largely into the composition of the animal machine, cementing together its various parts, and forming myriads of meshes for the reception of its nutrient and recrementitious particles.

Combined in various ways, these tissues constitute the different organs, whether parenchymatous, pulpy, glandular, or erectile. The parenchymatous structure is well exemplified in the lungs, which are composed of a soft, spongy, cellular substance, freely pervaded by vessels. Of the pulpy texture, a good illustration is afforded by the brain: here there is very little cellular matter, and the consistence of the organ appears to depend principally upon the presence of a large proportion of albumen. The glandular structure is still imperfectly understood. The liver, which forms the type of this system, is made up of myriads of granules lodged in distinct cells, the walls of which are evidently fibrous; but, what the precise nature of the contained substance is, whether essentially vascular, or of a character altogether peculiar to itself, is a point which is yet to be determined. The erectile texture, the most perfect example of which occurs in the penis, is composed mainly of arteries and veins, closely interwoven with each other, and susceptible of temporary erection, from the influx of blood.

The tissues, whether they be regarded individually, or as united together to form compound organs, are differently supplied with vessels, with nerves, and with lymphatics; and, consequently, although they are all important, each in its own way, to the well-being of the general system, some are much more so than others. Whole limbs, containing every variety of texture, may be removed, even in the human subject, without being necessarily followed by the dissolution of the economy; whereas, scarcely a single one of the inter-

nal organs, properly so called, with the exception of the spleen, can be extirpated without the destruction of life.

Connected together by vessels and nerves, as well as, in some instances, by continuity of surface, there subsists between the various parts of the body the closest fellow-feeling. In health, this sympathetic action is carried on so imperceptibly as to escape the attention of the physiologist; but no sooner is the system deranged, than it manifests itself at almost every point of the compass, serving at once to show the nature of the lesion, and the particular tissue, or set of textures, which it implicates. Every one is familiar with the powerful sympathy existing between the uterus and the stomach; the stomach and the lungs; the lungs and the heart; the heart and the brain. Nor is this fellow-feeling less marked in some of the other viscera. In duodenitis, nothing is more common than to see the liver disturbed in its functions; or, if the disease continue long, even its structure. The explanation of this is obvious. These two organs, the duodenum and the liver, are not only near neighbors, but the mucous membrane, which lines the former, is extended into the latter, by means of its excretory ducts, into the very centre of each granule. There is thus a direct continuity of structure, in consequence of which, disease cannot exist long, or in any considerable degree, in the one without being propagated to the other. So, also, with the urethra and urinary bladder; the vagina and uterus; the fauces and tonsils; the larynx and trachea; the nose and frontal sinuses; the eustachian tube and middle ear. All these cases are examples of what Mr. John Hunter has termed continuous sympathy.

In other cases, again, this sympathy displays itself in parts very remote from the one originally affected. In mumps, that is to say, in inflammation of the parotid gland, a not unfrequent occurrence is a swelling of the testicles, proceeding sometimes to such an extent as to destroy the structure and function of the organ. In what manner, or in accordance with what law of the animal economy, this association is established, it is impossible to say, as there is no similarity of texture any more than a direct nervous connection. The parotid is supplied with filaments from the ascending cervical nerves, and with branches from the fifth cranial; the testicle, with filaments from the spermatic plexus, formed by the sympathetic. Thus, then, there is no immediate tie between these organs, and yet, as has been stated, they often

display the strongest fellow-feeling. The sympathy existing between the uterus and the breast, and which is so conspicuous both in the healthy and diseased states of these parts, has been endeavored to be explained by the anastomosis of the internal mammary and epigastric arteries; but it need scarcely be remarked that this mode of accounting for the phenomenon is far-fetched and unsatisfactory, the vessels adverted to having by no means the intimate connection which some have ascribed to them. The same difficulty occurs when we attempt to ascertain the cause of the well-known sympathy between the cerebellum and genital organs. In regard to all of these organs, all that we know is, that there is such a bond of connection, and this, surely, for all practical purposes, is sufficient.

Writers have long since noticed the sympathy between parts of the same structure, situated remotely from each other. In gout, a disease which is seated in the fibrous textures of the extremities, it often happens, especially when the attack is violent, that the pericardium is involved,—the affection being transferred from its original situation to the chest. This is effected by what is called metastasis,—a term which only exposes our ignorance. The transfer must take place solely on account of the similarity of structure, not through any direct communication; for every anatomist knows that there is no connection whatever between the fibrous envelopes of the voluntary muscles and the fibrous covering of the heart. The serous and synovial membranes, the cutaneous and mucous tissues, strongly sympathize with each other, no doubt from the anatomical elements which enter into their composition, being so much alike. The liver and the skin are intimately associated by fellow-feeling; but how this is brought about, we have no means of determining.

I have thus briefly adverted to the relationship subsisting between the principal organs of the body, and endeavored to account for it upon anatomical principles. Much time might be occupied in the discussion of the subject; but I am not certain that it would result in much good. What is most worth knowing, is soonest learned, and least subject to dispute. The relationship which I have described should be carefully studied by the physician, as it will be impossible for him, without an extensive acquaintance with it, to comprehend some of the most extraordinary phenomena that are to be observed at the bedside of the sick.

Having made these desultory remarks, we may now proceed a step further, and inquire what constitutes disease; for every body knows what is meant by health. Disease may be defined to be a departure from the sound state, whether this departure consist simply in a derangement of function or structure. So long as the solid and fluid materials of the body act in concert, there cannot, of course, be any lesion; health, in all its vigor and perfection, must be the result; but when the blood and the tissues are arrayed, as it were, against each other, the harmony of the system is interrupted, unnatural action is set up, or, in other words, there is disease. This deranged action, it need scarcely be stated, may be limited, or it may involve a considerable number of organs and tissues at the same time.

Of the essence of disease, very little is known; indeed, nothing at all; nor can the utmost ingenuity hope to remove the veil which still envelopes the subject, until the physiology and pathology of the muscular and nervous systems shall be better understood. The proximate cause of morbid action, and the immediate cause of life in the healthy state, are as inscrutable to the human mind as the cause of gravitation, of attraction, and repulsion. All we can boast of is, that we know something of their effects; beyond this, it is extremely problematical whether we shall ever be able to penetrate. With this, indeed, every philosophical inquirer after truth should be contented, remembering that the secrets of nature are not easily detected, and that to God alone belongs the knowledge of the intrinsic property of things.

It has been already intimated, that diseases are functional or organic. As it is of the latter class that we shall more particularly treat in the following pages, it will be proper that we should speak of them somewhat at length. Before proceeding further, however, it behoves me to explain what I comprehend by the term organic. By pathological anatomiasts, the word is generally employed to denote some permanent change in the textures of an organ; but, in the sense that I would use it, I would not only include under it all such lesions, but also every temporary alteration which the tissues experience when in a state of disease. The term organic will then have a wider latitude; and, as expressing the same thing, we shall often have occasion to use the word structure. If this acceptance be adopted, it may perhaps be

doubted whether, under any circumstances, there can, strictly speaking, be a functional disease, or, in other terms, a mere aberration of the physiological state of a part, without some change in its anatomical elements. The question, at all events, is not settled.

Bearing in mind the above definition, it may be assumed, as a general proposition, liable to few exceptions, that all organic diseases, whatever be their seat or extent, are the result of inflammatory action, either of an acute or of a chronic kind. To many, this proposition may be startling ; nevertheless, if it be carefully examined, it will be found, I doubt not, to be grounded on fact. The truth of this remark will appear more evident as we proceed.

The second proposition that may be stated is, that every inflammation, irritation, or morbid action, is originally of a local nature ; that is to say, it makes its impression in the first instance always upon some particular part, texture, or organ. After this inflammation has continued for a longer or shorter period, it often happens that it extends to and implicates other structures. If the mucous membrane of the stomach, for instance, be fretted, the morbid action accruing from this cause will be confined at first to that lining ; or, in more comprehensive terms, the disease will be strictly local in its character : by degrees, however, as the disorder progresses, the adjacent parts, such as the submucous cellular tissue, become affected ; and, spreading still further, it next invades the muscular fibres of the organ, and, finally, the peritoneal covering. It is in this manner that most affections, which are originally local, extend their sphere of action, so as to become general, whether they be considered simply in reference to one organ, to several, or to a great number of them.

Inflammation of particular organs and textures is usually designated by adding the Greek term *itis* to the anatomical name of the part affected, as gastritis, laryngitis, pleuritis. In some instances, the old nomenclature is retained. Thus, inflammation of the tonsils is called quinsy ; of the eye, ophthalmia ; of the urethra, gonorrhœa ; of the parotid gland, mumps.

In regard to its progress, intensity, and mode of termination, inflammation is greatly modified by temperament, age, sex, habit, climate, and season, by the nature of the exciting cause, and, above all, by the character of the tissue in which

it is developed. The time of life which seems to be most obnoxious to this disease, is from the first to the tenth year, nearly one half of the entire mortality occurring during this interval. Affections of the cutaneous, mucus, and lymphatic systems, are particularly rife during this period, and carry off an immense number of children. Scarcely less common is inflammation of the arachnoid membrane. Pleuritis, pneumonitis, cerebritis, and hepatitis, with carditis, phlebitis, and arteritis, are comparatively frequent before the age of manhood ; from thence on, however, they are by no means unusual, and prove a fruitful source of destruction. Diseases of the genital organs are rarely observed before the age of puberty ; anterior to this period, these structures seem, indeed, in a great degree, to lie dormant in the system. Once roused into action, however, they deeply sympathize with the other viscera, and hence the frequency of organic maladies of the uterus, the ovaries, breasts, and testicles, towards the decline of life. Affections of the urinary bladder are comparatively rare in the young, whilst they are very common in the old.

Considered in reference to sex, some organs and tissues are more liable to be affected with inflammation than others. Cerebritis and splenitis, as well as carditis and arteritis, are infinitely more common in men than in women, probably, from the organs of the former being more exposed to perturbing agents, both of a physical and a mental kind. On the other hand, it is a well-established fact, that the female sex is much more obnoxious to inflammation of the peritonæum, of the veins, and lymphatics, than the male.

The seasons of the year in which inflammation is most prevalent, are winter and spring ; it is also more common in moist than in dry situations, and in cold and hot climates than in such as are temperate. In northern latitudes, the parts most frequently involved are the lungs, the air-passages, and the fibrous textures ; in tropical ones, the mucous membrane of the large bowel, the liver, and the skin.

The above are circumstances in the history of inflammation which, of course, we can only glance at ; the subject is certainly one of vast interest to the practising physician, and the attentive study of it cannot fail to be of the greatest benefit to him.

The rapidity with which this disease may run its course, is subject to a considerable number of circumstances, amongst

which the most important are the nature of the exciting cause and the structure of the part affected. As a general rule, it may be stated, that the more liberally an organ is furnished with vessels and nerves, the more easily will it be disorganized. Thus, an inflammation of the mucous membrane of the bowels will usually terminate much more rapidly either in health, or in death, than the same disease seated in a fibrous membrane, a tendon, ligament, or bone.

When an acute inflammation, after having existed for some time, does not terminate in the usual manner, it is said to become *chronic*. Paradoxical as it may at first sight appear, there are some varieties of this disease that assume a chronic form at the very moment of their outset. The irritation which accompanies the tubercular deposition, and some species of pure uncomplicated pneumonitis, are of this description.

Considered in regard to its degree of intensity, inflammation presents a great variety of forms, from the slightest possible derangement to the most intense morbid action. In this respect, therefore, the disease may be said to be mild, moderate, or violent. For the purpose of designating the first of these conditions, some writers are in the habit of employing the term *sub-acute*; a word which seems to me to be ill-chosen, and consequently conducive to error. The terms mild, slight, or moderate, are free from this objection, and will, therefore, be retained in the following pages.

The disease before us does not occur with equal frequency in all the organs and tissues of the body. There are some parts, in fact, in which it has been doubted, though, as I think, without any foundation in truth, whether this affection ever takes place. Such are the nails, the epidermis and the hairs. These structures are supposed, by general anatomists, to be destitute of vessels, and, therefore, incapable of performing any vital action. This, however, is merely a conjecture; the fact remains to be proved, and, for my own part, I feel as certain that these textures are susceptible of inflammation, as that the liver is, the stomach, or any other organ.

The cellular, mucous, serous, and dermoid textures are particularly prone to inflammation. In children, this is different. In them, the cutaneous and mucous textures are infinitely more liable to inflammation than the cellular tissue and serous membranes,—the frequency of their attack being, as nearly as can be, in the order here stated. It is here that

the disease can be studied with the greatest advantage, both as it respects its phenomena and modes of termination, inasmuch as it is usually well marked, intense in degree, and rapid in its progress. The synovial membranes, the fibrous envelopes, the bones, ligaments, and cartilages, with the muscles and their tendons, inflame with difficulty; but when the disease has once fastened upon them, they readily yield to its influence, the sufferings are often excessively severe, and the consequences very serious. The blood-vessels, nerves, and absorbents, are all more or less liable to phlegmasia. The conservative powers of these structures, especially of the former, is remarkable, and is strikingly evinced in cases of gangrene, where, as will be shown hereafter, they frequently retain their vitality amidst the half putrefied mass.

Of the organs, some are more ready to take on inflammation than others. Those which are most frequently affected, at least in this country, are the lungs, spleen, liver, uterus, and brain. The heart, ovaries, thyroid body, pancreas, prostate gland, testicles, and kidneys, are comparatively rarely the seat of this disease.

Respecting *specific* inflammation, some parts, again, are more prone to this disease than others. Thus, erysipelas commonly attacks the skin; anthrax, the subcutaneous cellular tissue; rheumatism, the fibrous envelopes of the extremities; tubercle, the lungs; scirrhus, the glandular organs. In the skin, numerous varieties of inflammation, both of an acute and chronic kind, are observed, that never occur in any other of the elementary textures and systems of the body. To this category specially belong the different species of eruptive and scaly diseases, which have their seat, for the most part, in the superficial portion of the dermis, the net-work of Malpighi, and the cuticle.

Although we have employed here the term "specific," yet it must be confessed that it is one of very equivocal signification; and, in order to remove all ambiguity respecting it, it will be necessary to determine, if possible, the sense in which it is understood by professional men. Almost all surgical authors agree in stating that there are two descriptions of specific inflammation; one of which is produced, it is alleged, by a peculiar condition of the constitution, and the other by the action of a special virus. Under the influence of the first are developed what are denominated the heterolo-

gous formations, such as tubercle and scirrhus, together with gout, rheumatism, and erysipelas; under that of the latter a disease which manifests a particular train of phenomena, which exerts its effects only upon a particular set of structures, and which can only be excited by particular causes. In such a classification, surgically considered, there is no special objection; but, viewed philosophically, or in reference to the laws of healthy and abnormal action, there is no ground whatever for such a distinction. All morbid action, indeed, whether acute or chronic, is, properly speaking, specific, or, what is the same thing, exerts a particular influence in relation to the particular structure which it implicates, being accompanied by particular symptoms and particular products.

Let us now proceed to investigate the nature of inflammation, its seat, and the phenomena which characterize it. In the whole range of medical science there is no topic which has attracted so much attention, and been the source of so much discussion, as the one now under consideration. Theory after theory has been framed, each in its turn to live for a while, and then give way to some other, either more ingenious, or fostered and protected with more talent and pertinacity by its author. To review the various notions that exist on this subject would be a task as irksome to the inquirer as it would be unprofitable to the student of pathological anatomy. At every step the mind would be bewildered with idle conjecture, and at the close of the investigation it would be no better off, so far as real and substantial information is concerned, than at the outset. We can only express our regret that so much time should have been misspent, so much talent wasted, in the construction of hypotheses, which, although sometimes plausible, do not, in the majority of instances, embrace a single well-ascertained fact to repay us for the trouble of examining them. Pathological anatomy is emphatically a science of observation and induction: in pursuing our inquiry, we shall therefore limit our remarks to a simple analysis of what is known respecting it; referring such of my readers as are fond of speculative reasoning to the various works that have been published on the subject within the last two centuries. He will there find a melancholy illustration of the fact that genius, however often it has wandered in quest of truth, has rarely succeeded in detecting it.

The *symptoms* usually enumerated as marking inflammation are redness, heat, pain, and swelling. These signs,

however, are not constantly present, and, as might be supposed, they are liable to vary according to the nature of the exciting cause and the character of the part affected. But these are not the only circumstances which occur in inflammation: in every case there is a perversion of the vital actions, attended with an altered state of the nutritive and secretory functions. To affix to these several conditions their respective value, it will be necessary to allot to each of them a considerable share of attention. Most writers, it seems to me, have attached too much importance to some of them, and too little to others; whilst they have entirely overlooked the fact that they are always greatly modified by the nature of the tissue in which the malady, of which they are the indices, is located. If we regard the four phenomena, redness, heat, pain, and swelling, referred to above, as being essential to the process, it will be at once perceived that there can be but few inflammations; and we shall therefore be obliged, in describing diseases, to invoke other names, such as irritation and fever; a blind adherence to which has unfortunately tended too much to retard the progress of pathological science. Boerhaave enumerated one hundred and fifty varieties of fever: had he enumerated a thousand more he would have been much nearer to the truth, for he might then have specified nearly every form of inflammation, whether occurring in the external parts of the body, or in the interior organs. The word "fever" is a conventional one, and is employed to designate not the nature or seat of a disease, but simply the phenomena which it manifests. So also with the term irritation. Mr. Travers and others have written extensive treatises on this subject; but have they pointed out any thing concerning the essential character of this disease? have they told us any thing of the peculiar condition of the nervous and vascular systems which accompanies it? So far as I am acquainted with their labors they have not done this; and yet men continue to talk about irritation, with its numerous varieties, as if they had the most perfect knowledge of its nature, seat, causes, and symptoms. A course such as this cannot but have a most dangerous tendency in practice; for what one physician describes as a fever, another will consider simply as an irritation, a third as an inflammation, and in this way no principles can ever be introduced as standards of treatment. The practice of medi-

cine must continue to ebb and to flow with every tide of professional opinion.

The time, however, cannot be far off, when the term fever must be entirely discarded from our books, and diseases named according to the tissues which they implicate. Then, and not till then, can it be expected that the laws of deranged action will be properly interpreted, or fully comprehended. All diseases, I feel confident, will ultimately be found to have a local origin and habitation ; and if this should ever be proved to be true, the whole class of febrile maladies, with its hundred varieties and subdivisions, will cease to have a place in our medical treatises. The artificial nosology of Sauvages, of Hoffmann, Cullen, Hosack, and a host of minor worthies, has had its day ; its authority is at an end, its sceptre is departed ; philosophy has usurped its place, and derides its aid. For the mighty changes which have been effected, and which are still going forward, in relation to the doctrine of morbid action, we are mainly indebted to a profound cultivation of pathological anatomy, which, since the time of Bichat, a period of scarcely thirty years, has advanced with such rapid strides, and reduced the healing art to a degree of certainty, which could scarcely have been anticipated. But this is a digression.

The *redness* of an inflamed part presents various shades, from the slightest rose to the deepest purple. There are some tissues which naturally contain little blood, or which convey only serosity, and these, of course, are never much discolored when affected with disease. The tendons, ligaments, and cartilages are seldom reddened, no matter what may be the intensity of the inflammation. In the fibrous membranes, such as the pericardium, the dura mater, and sclerotic coat of the eye, the discoloration is usually of a lilac or purple hue, with a shade of blue. In the mucous lining of the alimentary tube, the redness, in the early stage of the disease, is bright and florid, like that of arterial blood ; but, as it progresses, it often assumes a dark violet, or black appearance, especially when it is about to pass into gangrene. A striking exemplification of the truth of this remark is afforded by the mucous membrane of the fauces in the malignant form of scarlatina. In the beginning of this disease, the tonsils and adjacent parts are of a bright red, which is often, in the course of a few hours, converted into a deep purple. In the skin, the redness is sometimes of a scarlet color ; at others, it has

a yellow tinge, with various shades of mahogany. The yellow color is most commonly witnessed along with derangement of the liver; hence the frequency of its occurrence in the latter stages of erysipelas and anthrax. In inflammation of the pleura and peritonæum, the redness is, at first, of a lilac hue; afterwards of a scarlet, brownish, or violet. In the arachnoid there is rarely, if ever, any perceptible discoloration.

Inflammation of the spleen and liver is attended with a purple hue: when the brain is affected, the color is generally rosaceous, cineritious, or like the lees of wine. The salivary glands are usually of a pink complexion; the kidneys, of a deep violet; the testicles and ovaries, of a reddish yellow. In the lungs the color varies from the slightest rose to the deepest purple.

The redness is generally greatest at the centre of the inflamed part, from which it gradually diminishes in intensity until it reaches the natural standard of the tissue or organ in which it is located. It may be superficial or deep-seated; circumscribed or diffuse; arborescent or capilliform; punctuated or blotch-like. In some instances, as in the lining membrane of the arteries, the color is uniform, having the appearance as if it were dyed into the part. Whatever form it may assume, the immediate cause of it is an unnatural influx of blood into the capillaries,—the red globules being admitted in much greater numbers than in the sound state. So long as the circulation in these vessels is carried on vigorously, the redness in many of the tissues will be of a bright scarlet tint; but no sooner does the blood begin to stagnate, than the part assumes a darker hue, from some chemical change, probably, which the fluid experiences under such circumstances.

When a part is inflamed, is there really a preternatural development of *heat*? Mr. John Hunter thought there was not; and, in corroboration of this opinion, he adduces some experiments which he performed on the inferior animals. He made a wound in the right side of the chest of a dog, and, pushing the thermometer in contact with the diaphragm, ascertained that the temperature of the part was 101°. A large dossier of lint was then put into the opening, and its surface covered over with adhesive strips. On the following day, when the parts were in a state of inflammation, the foreign substance was removed, and the instrument being again introduced, the heat was found to be exactly the same as before, namely, 101°. Similar experiments were made on the rectum and vagina of

an ass, with the same results. There would thus seem to be no real increase of temperature. As a general rule, this is no doubt the case. Nevertheless, it has been clearly ascertained that, under certain circumstances, the reverse obtains.

The difference is certainly not so great in the external as in the internal parts of the body. Yet here there is reason to believe, that the temperature of the inflamed structure is frequently higher, by several degrees, than that of the blood. In the natural state, the average heat of this fluid, as I have ascertained by numerous experiments, is 96° , whereas, in disease, the thermometer sometimes falls as low as 92° , or rises as high as 104° .*

Every one knows how extremely hot the breath is in inflammatory affections of the throat, which can only be explained on the assumption that there is a partial increase of temperature. That the heat of the body, like every other physical endowment, is liable to be modified, is a fact which has been clearly established by the researches of physiologists. Sir Everard Home states that the oviduct of a frog ready to spawn, is two degrees hotter than the heart; and it is asserted by Dr. Granville, that, during labor, the temperature of the uterus sometimes rises to 120° , — the elevation appearing to bear a direct proportion to the action of the organ. A similar phenomenon has been observed to occur in plants. M. Huber found that, when the heat of the atmosphere stood at 21° of the centigrade thermometer, the instrument surrounded with spadices of the arum cordifolium, during the process of fecundation, rose as high as 42° .†

From the foregoing facts, it clearly appears that there is occasionally a considerable extrication of heat, even when there is no inflammation, or when there is merely a slight approximation towards it. The subject of animal heat is still somewhat enveloped in doubt: that it is dependent, in great measure, upon the nervous system, appears, however, sufficiently obvious; and if this point be conceded, no difficulty will be in the way in accounting for the alterations of temperature which occur in different states of the body. A deranged state of the nervous function would be accompanied, of course, with a corresponding modification of the heat of the part, whether this was higher or lower than the natural standard; and this, indeed, is precisely what happens when in-

* See "The Western Medical Gazette," vol. i.

† Ellis on Respiration, p. 204; also, Mayo's Physiology, p. 79, 4th ed.

flammation is seated in parts remote from the central organ of the circulation. In cases of erysipelas, furuncle, and anthrax, the thermometer has been observed, in numerous experiments made since the time of Mr. Hunter, to rise as high even as 107°. Similar results have been noticed in tetanus and acute rheumatism. There can, therefore, be no doubt whatever, as was before intimated, that, in certain cases of inflammation, whether occurring in the interior organs or in the external parts, there is a real augmentation of temperature, over and above what is observed at the heart, the great fountain of the circulation. In some parts of the body, such as the ligaments, bones, cartilages, fibrous membranes, and tendons, the extrication of heat must necessarily be very slight.

Pain is one of the most important symptoms of inflammation. Like redness, it varies in degree according to the nature of the affected part. As a general rule, it may be stated, that it is most keenly felt in those structures which are most liberally endowed with vessels and nerves. There are some tissues which, in the healthy state, are perfectly void of sensation, but which are exquisitely sensitive when laboring under disease. Thus, for example, a sound bone may be sawed, rasped, and even burnt, without the animal evincing the least uneasiness; but no sooner does it become inflamed than it gives rise to the most exruciating torture, leading often rapidly to hectic, with its whole train of evils. Similar phenomena occur in the fibrous membranes, the tendons, ligaments, and cartilages. In regard to the different viscera, it is a singular fact, that they generally experience much more pain when their coverings are affected than when their proper structure is involved. In hepatitis, the inflammation often proceeds to a most destructive extent before the individual is aware of his danger. Cerebritis is seldom so painful a malady as arachnitis; and a pleuritis, it is well known, is invariably attended with more suffering than a pneumonitis.

The degree of consciousness evinced by the mucous membranes, in a state of inflammation, is subject to much variety. In some situations the pain is excessive, whilst in others it is literally latent, — the disease proceeding in its work of disorganization without giving the individual, so to speak, the slightest intimation of it. In pulmonary phthisis, nothing is more common than to find ulcers in the ileum and colon,

sometimes of great size, where there was no sign whatever of their presence during life. It is a singular fact, in relation to this subject, that the pain is usually much greater when the inflammation is seated at the extremities of the mucous membranes, or at their junction with the skin, than when it involves the intermediate points. Bichat has endeavored to explain this difference, with perfect success, as I conceive, by referring it to a difference of organization. The mucous lining of the intestinal tube, and of the air-passages, which often manifests very little consciousness when inflamed, receives its nerves almost entirely from the ganglionic system; whereas the reverse is the case with the conjunctiva, the fauces, the urethra, and urinary bladder, the vagina and rectum, these parts being liberally supplied by filaments derived from the cerebro-spinal axis.*

Not only does the pain vary in degree, but also in its character. In the cellular tissue it is acute and pulsatile; in the pleura, sharp and lancinating; in the lungs and glandular viscera, obtuse and heavy; in the skin, prurient and smarting; in the bones, dull and gnawing. Sometimes the pain is persistent, sometimes intermittent, sometimes periodical; but, what is more remarkable than all is, that it is not unfrequently felt at parts very remote from the one originally and mainly affected. We have a familiar instance of this peculiarity in the hip disease of children, in which the earliest symptom complained of is pain in the knee. In hepatitis, the right shoulder is often the seat of the suffering; in cystitis, the head of the penis. We are sometimes enabled to account for this by the direct nervous communication, but more frequently the matter is entirely inexplicable. When inflammation is about to pass into suppuration, the pain usually becomes throbbing, and the patient is seized with shivering, with fever, and, in some instances, with delirium. After this process is fairly established, it almost always diminishes in intensity, or even wholly subsides. Pressure generally increases the pain, and in some cases the slightest touch of the finger produces intolerable suffering.

The proximate cause of this symptom has been variously accounted for. It is usually supposed to be owing to the unnatural influx of blood, the increased size of the capilla-

* See Bichat's General Anatomy; also, Horner's Pathological Anatomy, p. 81.

ries, and to the quantity of effused fluids, which compress, it is said, the delicate nervous filaments of the part concerned. This seems to me, however, to be taking only a partial view of the case. To complete the theory, it is necessary to assume that the nervous filaments themselves are affected, altered, or deranged, independently of the causes just adverted to; and in this idea there is nothing that is in the least repugnant to the laws of pathology. What the precise nature of the change is, we cannot, of course, define; nor is this a matter of much importance.

The effect of augmented circulation in producing augmented sensibility, is strikingly evinced in what occurs in inflammation of the hand. If the part be allowed to hang down, severe throbbing pain is instantly felt, which is as instantly relieved, in many cases, by putting the limb in an elevated position. Cold applications, by constringing the vessels, lead to the same result, and hence their beneficial effect in the treatment of external inflammation.

The fourth and last symptom of inflammation, which has been particularly specified by writers, is *swelling*. This is occasioned partly by the enlargement of the vessels, but chiefly by the effusion of serosity, lymph, blood, or pus, into the cellular tissue. In its degree it varies according to the laxity and vascularity of the part concerned. It is always well marked in the subcutaneous cellular substance, whilst the skin itself is generally little if at all affected by it. Inflammation of the serous and fibrous textures, the ligaments, tendons, muscles, cartilages, and bones, is usually unattended with swelling. The same remark is applicable to the internal viscera. The mucous membranes are rarely the seat of tumefaction. Hitherto, this symptom has been chiefly noticed in the vulva, at the mouth of the larynx, and in the conjunctiva of the eye.

Although the swelling generally comes on gradually, yet, in some instances, it proceeds with astonishing rapidity, at the same time that it spreads over a large extent of surface. The bite of the common bee, wasp, hornet, yellow-jacket, and rattlesnake, is often attended with the most frightful tumefaction, which makes its appearance sometimes in a few minutes, and speedily diffuses itself over an entire limb, or even over the whole body.

From the hasty survey which has been taken of these symptoms, we are authorized to conclude that they are by

no means entitled to the stress which has been generally placed upon them by writers. In many instances there is an entire absence of at least one or two of them, and yet the part is absolutely in a state of higher inflammation. How often does it not happen, that enteritis is high up, and goes on to destructive disorganization, without even the slightest indication of its presence? In arachnitis, the only symptom, frequently, is merely a severe cephalalgia, with delirium and partial paralysis. The patient dies, and, on examination, the membrane is found to retain its natural thinness, and to be as free from injection as in the sound state. In such a case, should there be but little effusion of serum and fibrin, a superficial observer might conclude that there never had been any inflammation, or that what he saw was the result solely of irritation. The injurious tendency which such a mode of procedure would exert on the practice of medicine is too obvious to require any comment in this place. In reasoning on this subject, the physician should constantly bear in mind the important fact, that the symptoms which have been enumerated above, although they are frequently all present, are not necessarily so, and that the absence of some of them is not a sufficient proof that there does not exist inflammation. By such course alone can he expect to escape error.

Besides these phenomena, there is always, in well-established inflammation, a perverted state of the vital action. In none of the tissues is this state, perhaps, ever entirely absent; yet, as might be expected, it is much more conspicuous in some than in others. It is sometimes, indeed, the only symptom present, or the only one which can be recognized. In gastritis, the only manifestation of which is frequently irritability, without heat or pain, or uneasiness on pressure, the digestive function is entirely suspended, gastric juice is no longer secreted, and the organ is oppressed by the mildest articles of food. In the duodenum the process of chylification is interrupted, retarded, or perverted; in the liver, bile is either no longer deposited, or it is furnished in small quantity, and vitiated in quality. In high degrees of inflammation of both kidneys, there is sometimes a total want of urine, and the individual dies under all the symptoms which characterize the retention of that fluid in the bladder. It should be observed here, that, as a general rule, this derangement of the functional action is always greatest when the irritation is at its height, and that, from this period on, it gradually dimin-

ishes until the disease subsides. When the office of an organ is to receive some external impression, it does either not so at all, or very imperfectly. The inflamed eye is no longer able to take cognizance of light; the schneiderian membrane does not notice odors; and the ear is incapable of distinguishing sounds. When the brain is affected, the intellectual faculties are deranged, and the individual raves with delirium, or lies like an automatic mass, dead to all surrounding impressions.

The function of absorption is often very much impaired in this disease. A solution of strychnine applied to an inflamed serous membrane, as the pleura, will not result in any injury to the animal, or only in a very long time after the contact has been effected. In some experiments made by Dr. Gendrin, of Paris, and which I shall hereafter notice more particularly, prussic acid was applied with impunity to the conjunctiva of the eye, the schneiderian membrane of the nose, and the mucous lining of the vagina, which had been previously inflamed by hot oil and tincture of cantharides. Notwithstanding the results of these experiments, correctly stated, no doubt, by the French philosopher, experience daily teaches us that, whilst some substances are rejected by the organs and tissues, when in a high state of inflammation, there are others, the absorption of which is still, to a certain extent, carried on. In the stomach, for example, mild diluent drinks, such as gum-water, slippery-elm tea, or arrow-root, are rapidly conveyed into the circulation, and are usually employed more or less by the practitioners of different countries. If the quantity given, however, be so great as to oppress the affected organ, absorption will cease, and the fluid will be ejected. In the serous cavities, nearly the same circumstance is observed. When the fluid that is effused in these situations exceeds several quarts, the absorbents appear to be incapable of taking it up, and the surgeon is obliged to evacuate it. Acetate of morphia, applied to a piece of skin that has been inflamed by a blister, will tranquillize the system nearly in as short a period as when it is introduced in the ordinary way.

Not less remarkably altered is the nutritive function. If an organ remain for a considerable time inflamed, the particles which are requisite for its growth and nourishment are withheld, and, in consequence, it gradually sinks into a state of atrophy. In more rapid cases, the part retains its natural

bulk, but undergoes a change of color and consistence, from the imperfect admission of blood, and from some derangement of the molecular structure. This state is remarkably conspicuous in several of our organs and tissues, and will be described hereafter under the name of softening, mollescence, or *ramollis sement*.

The next subject which we have proposed to discuss is the *seat* of inflammation. That this is in the capillary vessels is a fact concerning which there exists, I believe, no dispute. Of the nature of the vessels themselves, however, different views have been expressed by anatomists, and it will be necessary, therefore, before proceeding further, to examine briefly their situation, structure, and functions; for in this way alone can we expect to throw any real light upon the nature of the present disease.

The capillaries are those minute tubes which are every where interposed between the arteries and the veins. It was at one time imagined that they formed a distinct set of vessels by themselves, perfectly independent of the rest of the vascular system,—an opinion which had been abundantly disproved by the researches of modern anatomists. It is now well known that they not only communicate directly with the arteries and the veins, but likewise that they are, as it were, merely so many prolongations of them. What their precise structure is we have no means of determining; nor is it known where the arterial capillaries terminate, or the venous begin. The transition is too gradual, perhaps, to enable us ever to arrive at any positive conclusion in relation to the subject.

The walls of the capillaries, as may be imagined, must be extremely thin, delicate, and transparent, otherwise it would be much easier to discern them. Bichat states that they are formed entirely out of the inner arterial and venous membrane, the other tunics being excluded, as he alleges, from their composition. An opinion precisely similar to this is advanced by Beclard. He asserts that the parietes of the capillaries are scarcely to be distinguished from the substance of the organs in which they are situated, and thence draws the inference that they are rather formed out of this substance than that they possess walls of their own, acknowledging, however, at the same time, that it is not impossible that the internal tunic of these vessels is uninterruptedly continued from the arteries to the veins. Admitting, as we have already

done, the utter impossibility of determining the precise point at which the arterial tubes in question terminate, and that at which the venous tubes commence, it would seem that the doctrine of the two French anatomists is entirely too exclusive in its bearings to entitle it to our confidence and regard. It is true, neither dissection nor microscopic observation can afford us much aid in solving the difficulty; for the vessels are altogether too minute to enable us to investigate their structure with any degree of accuracy; still, where these means fail us, we are warranted in going to analogy, and in availing ourselves of its assistance.

Taking it for granted that the privilege above alluded to properly belongs to us on the present occasion, let us extend our examination to other tubular structures, and see if we cannot find a more philosophical method of disposing of the question than that resorted to by the French anatomists. Let us take the excretory duct of the liver, and follow it along its ultimate ramification in the organ whose secreted fluids it is intended to carry off from the system. In the early part of its course it consists, plainly enough, of two tunics, which, as they extend into the substance of the viscus, become so excessively attenuated that it is quite impossible not only to separate them from each other, but even to distinguish them from the surrounding textures. Now that the inner membrane is prolonged as far as the very point at which the tube terminates, or rather where it takes its origin, no one can for a moment doubt, for the bile is a highly acrid fluid; and hence nature, in order to guard against suffering, has wisely furnished the canal with a mucous lining. But is it reasonable to presume that, because we can no longer discern the external tunic, it must necessarily be wanting? Is it not more philosophical to suppose that both membranes exist, than to say that one is preserved and the other lost? This conclusion involves nothing that is either absurd or improbable; and, although not founded on actual observation, it is much more in conformity with sound anatomy and physiology than any other that has been framed in relation to the subject. If, now, we apply this mode of reasoning to the capillaries, it will at once be perceived that the theory of Bichat and Beclard is untenable; and that these vessels, instead of possessing, as they imagined, only one tunic, have precisely the same number as the arteries and veins, between which they are situated. If this idea be adopted, it follows, as a

necessary corollary, that the capillaries are nourished and animated, like the rest of the vascular system, by vessels still more minute, and by nerves so excessively delicate as to elude even the most powerful microscope.

Viewed in reference to their caliber, the capillaries are divisible into two classes. The one embraces those minute tubules which, though invisible to the naked eye, are found, when examined with the microscope, to be capable of carrying a continuous stream of blood, so as to give the part in which they are located a red appearance; the other includes those delicate vessels, the cavity of which is so small as to admit only a single globule at a time, and which it is extremely difficult to detect even with a good magnifier. By reflecting for a moment on the size of the red particles of the blood, estimated by most writers to be about the three thousandth part of an inch, the reader will be struck with the great tenuity of these vessels.

That the capillaries do not abound equally in all the organs and tissues, is a fact which was rendered sufficiently obvious when speaking of the phenomena of inflammation. The parts which form the basis of the skeleton, together with the tendons, the cellular substance, the epidermis, nails, and hairs, have, comparatively, few of these vessels after the body has attained a certain degree of development. In the early stages of life, however, most of these structures are highly vascular, and can be readily injected. The serous membranes appear to possess very few capillaries; in the healthy state, in fact, none can be discerned in them; yet, when inflamed, they are rendered highly vascular, and thousands of minute vessels, which before were invisible, are now perfectly distinct, giving the affected part a beautiful reddish aspect. The capillaries abound in the mucous membranes, the skin, the liver, spleen, lungs, and kidneys. They are also very numerous in the heart, the muscles of voluntary life, in the brain, and in the pia mater.

Thus situated, and thus constituted, the capillaries form by far the most interesting as well as the most voluminous portion of the vascular system. To it are confided the important functions of nutrition. Secretion, calorification, and perhaps also, at least in part, that of absorption. Whilst the larger vessels perform the office merely of sanguiferous, it is in the capillaries that the fluid and solid materials are brought into those intimate relations which precede the conversion of

the one into the other, and which are necessary to their vitality and support. In inflammation the capillaries play a most important part: blood is sent into them in an unnatural quantity; their action is perverted, and, in consequence, various fluids are poured out which are foreign to the normal condition of the economy. These, however, are not the only structures that are affected. It is highly probable, I think, that the nervous filaments are equally engaged in the morbid enterprise, though this is a point concerning which our information is extremely slender. The fact is certain that neither of these tissues can be long involved without the other participating in the derangement.

The joint agency of the nervous and vascular systems, in the production of inflammation, has been happily illustrated by the researches of Magendie, Brodie, and Philip. The first of these distinguished physiologists ascertained that, when the ophthalmic branch of the fifth pair of nerves is divided in the cranial cavity of a rabbit at the Varolian bridge, inflammation is speedily lighted up in the surface of the eye, which eventuates in opacity of the upper segment of the cornea. What is still more remarkable is, that, when the nerve is cut on the petrous portion of the temporal bone, so as to involve the destruction of the ganglion of Gasser, the resulting irritation is not only more violent in degree, but much more deeply seated, as well as more deplorable in its effects, the consequence being nothing less than a complete disorganization of the organ.

Analogous effects follow the division of the pneumo-gastric nerves. When these cords are cut high up in the neck, the lining membrane of the air-passage assumes a dark color, the lungs are engorged with black blood, and an abundance of serosity is poured out into the parenchymatous texture, as well as into the pulmonary vesicles and the minute branches of the bronchiæ. The pleura generally participates in the irritation, and there is almost always more or less inflammation of the stomach, with a suspension of the secretion of the gastric juice.

The investigations of Mr. Brodie have successfully elucidated the phenomena which ensue upon tying the brachial plexus of nerves. Animals that have been subjected to this experiment are seized, in a short time, with inflammation of the integuments of the remote parts of the limb, which gradually progresses until all the soft structures are invaded

by gangrene. The results of this experiment enable us to account for certain circumstances that have long since been noticed by practitioners in particular morbid states of the system. It is a remarkable fact that a part affected with palsy is much less capable of withstanding the ordinary impressions of physical agents, than one receiving its customary supply of nervous influence. A burn in a paralytic person creates much more serious mischief than in one that enjoys perfect health ; and the same is true in regard to blisters and other irritants, the injudicious application of which often leads to the destruction of large portions of the skin and subjacent cellular tissue. There is little doubt that the inflammation of the bladder, which always supervenes upon serious injury of the spinal marrow, is caused in the same way ; that is, by the interruption of the natural supply of the nervous influence.

In whatever manner parts are deprived of their nervous influence, it is presumable that they are brought under relations somewhat analogous to those of a frozen limb. The temperature is lowered, the sensibility impaired, the process of nutrition perverted,—in a word, the natural connection between the vessels and nerves is broken up, and hence ensues that series of phenomena known under the name of inflammation. Let us pursue this subject a little further.

The very first step in the process of inflammation is an altered sensibility of the part, produced by some hurtful agent, which the system makes an effort to dislodge. To effect this, the local impression is reflected upon the cerebro-spinal axis, and through this again upon the heart, which, being sympathetically incited to increased action, more blood flows to the part concerned than it is accustomed to receive, at the same time that the capillaries are perceptibly dilated. Those who maintain that the capillaries possess an inherent contractility, by virtue of which they aid in the circulation, will probably feel disposed to deny the agency of the heart in bringing about this preternatural determination of blood ; to such I will only say, that if they will carefully study the subject, they will arrive at a different conclusion. That these vessels do contract and dilate, no one will dispute ; for the experiments of Hunter, Wilson Philip, Thompson, Hastings, and other writers, have fully decided this point ; all that I contend for is, that the capillaries have no vermicular movement, and therefore they are incapable of carrying on

the circulation without the direct influence of the heart. In the ineptive stage of inflammation, this sympathetic action of the heart is no doubt so slight as frequently to escape the attention of the observer: as the disease progresses, it assumes a more distinct character, and can always be easily recognized.

The phenomena above alluded to, namely, the preternatural influx of blood, and the dilatation of the capillaries, can be easily detected by exciting irritation in the mesentery of a rabbit, the tail of a tadpole, the fin of a fish, or the web of a frog's foot,—parts which are perfectly transparent, and therefore well calculated for the purpose. On viewing these structures with a microscope, in the sound state, numerous channels will be observed filled with blood, the red globules of which roll along in the most regular and beautiful order. If they be now irritated with spirits of wine, hot water, or diluted acid, the little rivulets just referred to will be found to become dilated, from the manner in which the blood is crowded into them by the heart, which, in order to remove the local difficulty, is excited into sympathetic action. In a few minutes hundreds of vessels, which were previously invisible, will be seen shooting out in different directions, and connecting themselves with the sides of those that appeared in the first instance. These are not new channels, but old ones appertaining to the second class of capillaries, which are rendered evident by the intromission of red particles, which are either excluded in the healthy state, or pass along them in so slow and gradual a manner as to elude the eye of the beholder. The little bodies which are thus introduced do not circulate, at first, with the same facility as in the other parts of the body; for, as the dilatation of the little rivulets takes place by degrees, they have to force their way, and hence, after having advanced a short distance, they retreat slightly immediately after each pulsation of the heart, rebounding, as it were, upon each other. In this manner they travel on, surmounting every obstacle, until they finally reach the corresponding capillary veins, into which, as they are considerably more capacious, they rush, as into a vortex. Such are the initial steps of inflammation. If the process be now checked by the removal of the exciting cause, the phenomena referred to gradually disappear, and the part recovers its natural tone and condition.

If, on the other hand, the inflammation be allowed to pro-

ceed, another series of changes may be witnessed, surpassing, if possible, in point of interest, those we have just described. The circulation now completely ceases; the blood assumes a dark modena color, and the coats of the vessels are rendered so soft as to be liable to give way on the slightest force. With these alterations the healthy functions of the part are suspended: it is red, hot, painful, and tumid; and its molecular intervals are filled with serosity or coagulating lymph. In this stage of the malady, the capillaries contain thick, viscid, partially clotted blood, which adheres with great tenacity to their inner surface, and opposes an effectual barrier to artificial injection, or to the removal of the fluid by pressure or ablation. In violent cases the blood escapes from the diseased vessels, and, forcing its way along the cellular tissue, forms new channels, through which it afterwards continues to circulate. This interesting phenomenon, which has been frequently noticed by Kaltenbrunner in the inflamed mesentery of the rabbit, is strictly analogous to what occurs in the organization of adventitious membranes,—a subject to which the attention of the reader will be subsequently directed.

Inflammation, it will thus be seen, is a gradual process, which is preceded and accompanied by certain stages. Of these, three are recognized by Kaltenbrunner. The first he denominates the stage of incubation; the second, the stage of congestion; the third, the stage of inflammation, properly so called. Each of these is characterized by particular phenomena, the most important of which have been already described, in the order, as nearly as may be, in which they appear. To this arrangement I can see no special objection: it should be recollected, however, that it is altogether artificial, and that the stages which it recognizes are frequently so blended as to render it impossible to distinguish them from one another. Contrary to what might be inferred from analogy, Kaltenbrunner has ascertained the singular fact, that more time is usually required for inflammation to be developed in highly vascular organs, as the lungs and peritoneum, than in parts in which the circulation is more tardy and less perfect, as the liver and kidney. It is worthy of remark, however, that when the disease is once fairly established, it progresses much more rapid in the former than in the latter of these structures.

Another striking phenomenon is the distended condition of the larger vessels leading to the inflamed part. When the

disease is at its height, the congestion often extends to a considerable distance; the blood is unnaturally dark, thick, and viscid, and artificial injection is difficult, sometimes impracticable. It has been alleged that the larger arteries in the immediate neighborhood of the lesion occasionally pulsate with preternatural force and frequency; but this is an assertion which is unsupported by proof, and which is, moreover, in direct opposition with every principle of physiology. The intensity of the morbid action is generally greatest at the centre of the inflamed part, from which it gradually, and, in some instances, suddenly diminishes, until it loses itself in the circumjacent textures.

Having thus finished the notice which I proposed to take of the anatomical characters of inflammation, it will only be necessary, in concluding this part of the subject, to allude to the principal circumstances which are capable of producing congestion and discoloration of the different organs and tissues, imminently prior to, during, or subsequently to, the extinction of life. In a practical point of view, no less than in a pathological, this is a matter of no trifling moment, yet one concerning which there still prevails a great deal of misapprehension in the minds of medical men.

The causes under the influence of which congestion and discoloration may be produced before death, are referable, first, to mechanical obstructions, interfering with the free return of the venous blood; and, secondly, to the effects of stimulating agents, introduced into the body either as food, drink, medicine, or poison. The latter of these will be examined in another place, and it will therefore only be necessary, on the present occasion, briefly to inquire into the character of the former.

Whatever has a tendency to interrupt the passage of the blood to or from the heart, must be a cause of congestion in the organ where the accumulation takes place. The obstruction, which may exist in any part of the body, may be produced by a great variety of circumstances, as the presence of a tumor, some morbid deposit, or the obliteration of a large vessel. But the more common source of the difficulty, perhaps, is organic lesion of the heart, particularly of its valves, of the auriculo-ventricular apertures, or of the mouth of the aorta or pulmonary artery, opposing the progress of the blood, and throwing it back upon other organs, which thus receive an undue supply of it. That congestion may, and often is,

produced in this manner, is a fact too well known to admit of dispute ; but it is by no means so clear that it does not, inasmuch as it is of a permanent nature, give rise to results very different from those we are now contemplating,— in a word, that it does not lead to inflammation, or to what Andral has termed active hyperæmia. However this may be, it seems to me that pure, uncomplicated congestion, in whatever parts of the body occurring, must uniformly depend upon one or other of the following circumstances : 1. Obstruction of the heart and great vessels, by the formation of fibrinous concretions during the last struggles of life. 2. Partial paralysis of the heart, disqualifying it, to a greater or less extent, for carrying on the circulation. 3. Asphyxia, whether induced by actual strangulation, the inhalation of deleterious gases, or difficult dissolution in ordinary sickness.

The congestion produced by the first two classes of cases is generally partial, and almost always limited to the more dependent situations ; that, on the contrary, which results from asphyxia usually pervades the whole body, and is particularly conspicuous in the skin, the conjunctiva, the mouth and lips, in the lungs, the heart, and the great vessels, which are often distended, to their very utmost, with black fluid blood. In either case, the resultant discoloration is of a dull bluish tint, as well as much more uniform than in inflammation.

The causes which operate in the production of congestion and discoloration after death, are the gravitation of the blood, and the transudation of this fluid, or of some of its component elements, through the parietes of the vessels.

It is a well-ascertained fact, that, with the cessation of life, the blood, in obedience to the laws of gravity, gradually subsides to the more depending structures, distending their vessels, both large and small, and imparting to them its peculiar color. Under ordinary circumstances, these appearances are most conspicuous in the posterior parts of the body ; but observation has fully shown that they may be produced in any situation, laterally, in front, or behind, simply by placing the subject in a particular position, and keeping it there until it is deprived of its warmth. The congestion thus arising is limited, in great degree, to the veins, which are often as thoroughly distended as if they had been filled with injecting matter : they spread out in an arborescent manner, and are generally traceable to large trunks, which are themselves frequently quite full of blood. Their contents are of a dark

modena color, perfectly fluid, or partly fluid, and partly coagulated, and easily pressed from one place to another; the reverse of which, as was before stated, is the case when the congestion depends upon inflammation. At what period the injection begins has not been accurately determined: there is reason, however, to believe that it frequently commences several hours, or even days, prior to dissolution. In the generality of instances, as is well known, the approaches of death are gradual, one organ fails, as it were, after another, and whilst some parts are still actively engaged in the discharge of the duties which nature has assigned to them, others have either ceased to act, or have become so crippled as to be able to perform their functions only in a tardy and imperfect manner. Under such circumstances, observation warrants the presumption that the blood, from the feeble impulse exerted upon it by the heart, the eentral organ of the circulation, accumulates in the more dependent parts of the organ, in a mode calculated to produce local congestion, with a corresponding augmentation of color, long before the solids and fluids are consigned to the influence of decomposing agents.

The structures which are more particularly liable to be affected by this kind of injection, are the posterior portions of the lungs, of the liver, and of the kidneys, for the reason not only that these organs are highly vascular in the normal state, but that the individual usually lies upon his back, both after and for some time previously to death. For the same reason, the skin of the back part of the neck, trunk, and extremities is always much more filled with blood than at the sides or in front, where the cutaneous vessels are comparatively empty. The accompanying discoloration varies with the nature of the affected tissues, from slight rose to deep red, as in the most intense inflammation. Ordinarily, however, it is very faint, more uniform, and diffuse than in disease, and much more easily removed by pressure and ablution.

The second cause capable of imparting an abnormal color to the animal textures after death, is the transudation of the blood through the parietes of the vessels. It is a law of the healthy economy that the vessels should retain the fluid which is destined to pass along them without suffering permeation; but no sooner is the vital principle withdrawn than the body is brought under the influence of surrounding agents, which speedily change the relations of its various

component elements, and impress upon them a total alteration of character. Amongst these, the most important, in connection with the present topic, is the percolation of the blood through its vessels, and its diffusion through the solids, by which the latter are rendered unnaturally red and moist, as if they had been steeped in some coloring liquid. The redness thus produced, as it almost always depends upon petrificative decomposition, rarely appears within the first four and twenty hours after death, unless there is a very high degree of summer heat conjoined with atmospheric humidity. Nor does it occur with equal facility or frequency in all parts of the body: the structures which are soonest and most extensively affected are, the endocardial lining of the heart and the internal tunic of the arteries and veins, where it is often mistaken for that of inflammation. To this, however, it bears only a very remote resemblance. It is usually a mere scarlet stain, as if it were attached to the free surface of the membrane, over which it is generally uniformly diffused, without any particular alteration in the subjacent parts, or any deposit upon the interior of the tube. Sometimes the redness occurs in bands, patches, streaks, points, or arborescent lines, with intervals retaining the ordinary appearance. The latter variety is frequently observed along the course of the larger veins of the stomach and bowels, in warm, wet weather, when the examination is delayed beyond twenty-six hours. Similar phenomena are occasionally witnessed, under like circumstances, in the skin of the back part of the body, particularly in those regions which are subjected to pressure. Finally, as the process of decomposition advances, the discolouration, losing its scarlet character, assumes a muddy, brownish aspect, with various tints of green, and, at the same time pervades, to a greater or less extent, all the softer textures of the body. These changes take place, all other things being equal, much sooner in warm than in cold weather, and in full, plethoric individuals, than in such as die in a state of general anaemia.

Exposure to the air is another cause of cadavaric coloration, which demands brief consideration in reference to the present subject. This variety of redness, which generally begins to appear within a very short time after the removal of the organs from the body, always proceeds with great rapidity in warm weather, especially when the part is brought under the direct influence of the solar rays. The

structures in which it is most commonly observed, are the spleen, liver, kidney, and heart, the internal tunic of the arteries and veins, and the mucous membrane of the alimentary tube. In nearly all these situations, the color is of a bright scarlet, like that of arterial blood, and uniformly diffused over the whole, or the greater portion, of the organ in which it occurs. In the stomach and bowels, it occasionally presents itself in small florid specks, as if the surface of the living membrane had been dusted over with vermillion. Absorption of the oxygen of the air, and the admixture of this gas with the blood, are the causes, undoubtedly, under the influence of which this species of coloration is established. Hence, by exposing the affected organ, for a few minutes, to a gentle stream of water, or immersing it in diluted vinegar, it almost instantly changes its florid appearance, and assumes a dark purple hue, similar to that of venous blood.

Such are the varieties of congestion and discoloration, resulting from causes which exert their influence during the last moments of existence, or within the first few days after death. Although, in general, easily distinguishable from those of inflammation, yet it must be confessed that the diagnosis is sometimes extremely difficult, if not impossible, so closely do they run into each other. Under such circumstances, a careful analysis of the symptoms of the case, with the effects of the remedies employed, and an attentive consideration of the ordinary products of morbid action, are absolutely indispensable to a correct appreciation of the nature and character of the supposed lesion. Should there be merely some degree of redness, with ramiform injection, traceable to some large venous trunk, unaccompanied by effusion, softening, opacity, induration, thickening, or ulceration, the presumption is strong that these appearances are the result solely of congestion, produced by some one or more of the causes previously pointed out. If, on the other hand, the discoloration and vascularity are associated with some, or all, of the anatomical characters here indicated, it must be concluded that they are dependent upon inflammatory irritation, since they afford the best possible evidence of the existence of that lesion.

Can inflammatory redness exist during life, and yet entirely disappear after death? This is a question, undoubtedly, of no little moment, in a practical point of view, which will be duly considered when we come to speak of the

anatomical characters of inflammation of the mucous membrane of the alimentary tubes.

After what has been here stated, it will not be expected that we should say much respecting the various theories, or, rather, hypotheses, that have been projected in relation to the proximate cause of inflammation. A few only of the more prominent will be noticed. The first which I shall mention is that of Boerhaave, which supposes that the disease essentially consists in an obstructed state of the capillaries, produced by some morbid lentor of the blood, or by the entrance of the red globules into vessels not fitted to receive them. This opinion rested on the belief, that the sanguineous particles are remarkably complicated in their structure, each red one consisting of six serous, and each serous of six lymphatic ones, for the conveyance of which three kinds of tubules were imagined, as channels of communication between the arteries and veins. By getting into a wrong vessel, the globules might very readily produce obstruction, and thus excite inflammation.

The late Dr. Cullen, of Edinburgh, no less distinguished for his eloquence as a teacher than his ability as a writer, conceived the idea that inflammation was merely a sort of spasmotic contraction of the small vessels, interrupting the passage of the blood. This state, he supposed, was sometimes the effect of direct debility; and he imagined, moreover, that there was frequently a peculiar condition of the whole vascular system, which predisposed to this affection, and which received from him the name of the *phlogistic diathesis*. This theory, notwithstanding the favorable manner in which it was for a long while regarded, has the disadvantage of being unsupported by a single fact. So far from the vessels being contracted in inflammation, it is now well ascertained, as was before mentioned, that they are invariably dilated, and that, in consequence of this, they always admit an unusually large amount of blood, which could not happen were the reverse of this the case.

Dissatisfied with the crude conjectures of Boerhaave, of Cullen, and other writers, another theory was proposed by Dr. Vacca, an eminent Italian pathologist, soon after the middle of the last century. In his treatise on inflammation, published at Florence, in 1765, he maintains the opinion, that this disease invariably results from sanguineous congestion, attended with more or less debility of the affected part.

The first step in the process is relaxation of the capillary vessels, which allow them to be abnormally distended by the blood that passes through them. To this increased quantity of fluid he ascribes the redness, heat, pain, and turgescence, which are always more distinctly marked in proportion to the dilatation of the minute arteries and veins, the violence of the exciting cause, and the natural vascularity of the part concerned.

Since the time of Vacca, the theory of diminished power of the vessels has been warmly advocated by a considerable number of pathologists, especially by Dr. P. Wilson, Dr. Hastings, and Dr. Thomson. The experiments which were performed by these distinguished writers, although they are at variance as respects some trifling points, all tend to show that inflammation essentially consists in a weakened action of the capillaries, by which the balance between them and the large vessels is destroyed, and congestion is the result. Opposed to these views, again, are those of Mr. Hunter and Dr. Gendrin, of Paris. These pathologists have both minutely investigated the subject of inflammation in all its departments, and they adopt the belief that the primary cause of the disease is an increased action of the vessels. Amidst such a discrepancy of opinion, it might seem, at first sight, extremely difficult, if not impossible, to arrive at any satisfactory conclusion. To me, both views appear to be correct, but not in the sense advocated by their respective authors. In the early stage of the disorder, we have every reason to believe, from the phenomena which are exhibited under the microscope, that the vessels have an augmented action ; subsequently, however, when the disease is fully established, the capillaries are partially paralyzed, the blood ceases to circulate, the function of nutrition, of secretion, and absorption, is interrupted, and every thing indicates the diminished power of the part.

Finally, inflammation ends in different ways. When it gradually subsides, without any untoward occurrence, it is said to terminate in resolution. In some cases it relieves itself by an effusion of serum and of lymph, by suppuration, by hemorrhage, and by softening. At other times, the part loses its vitality ; and it is then said to end in gangrene. Philosophically speaking, some of these states are merely *conditions*, not terminations of inflammation. Thus, suppuration is absolutely, from first to last, a phlegmasial process ;

and so of softening, of the effusion of serum, and of the deposition of lymph. It is therefore rather in compliance with professional usage than with the sound principles of pathology, that we should continue to employ this vague expression. If this fact be borne in mind, the reader will not be likely to fall into error.

With respect to acute inflammation, the following terminations may be recognized: 1. resolution; 2. effusion of serum; 3. deposition of lymph; 4. suppuration; 5. hemorrhage; 6. softening; 7. gangrene. These different terminations constitute merely so many degrees of inflammation. Thus, suppuration indicates a higher grade of action than lymphization, and a milder one than hemorrhage, softening, or gangrene. We might thus construct a sort of *phlegmasial scale*, the index of which would be the product of the disease, or the mode in which it terminates.

Chronic inflammation has fewer terminations or conditions than the acute. The principal ones may be thus stated: 1. ulceration; 2. granulation; 3. cicatrization; 4. induration.

Besides these conditions, chronic inflammation may occasionally be attended with hemorrhage and softening, or even terminate in gangrene. These occurrences are, however, extremely rare, and are seldom witnessed except when there is a sudden supervention of acute phlegmasia. Let us now proceed to describe these different states, in the order in which they have been enumerated.

CHAPTER II.

Of the Effusion of Serum.

Occurs, to a greater or less extent, in almost every Inflammation.—Œdema, Anasarca, and Dropsy.—Color, Consistence, Quantity, and chemical Composition.—Usually the result of a mild degree of Inflammation.—Conclusion.

AN effusion of serum, to a greater or less extent, occurs in almost every inflammation. There are some varieties of this disease in which, indeed, it forms the chief if not the only symptom. It is seen most frequently in the interstices of the cellular tissue, on the surface of the serous membranes, in the parenchymatous texture of the lungs, in hydatids, and serous cysts. There are some structures which, from their dense and compact nature, do not seem to allow of this infiltration. Of this description are the liver, kidney, womb, prostate gland, and spleen, together with the tendons, aponeuroses, ligaments, cartilages, and bones. Very little serum is effused in the brain, spinal cord, nerves, vessels, and mucous membranes. With respect to the latter, the parts most frequently and extensively affected, are the margins of the glottis, the conjunctiva, and the nymphæ. Considered in reference to the subcutaneous cellular tissue, the effusion occurs much more frequently in the inferior extremities than in the superior; in the genital organs than in the trunk; in the eyelids than in the face, head, or neck. The lymphatic ganglions and the inter-fibrillar substance of the muscles are often the seats of considerable serous infiltrations, especially in weak cachetic subjects, or those who are worn out by severe and protracted diseases. Large quantities of this liquid are frequently discharged by the mucous membrane of the bowels, in diarrhœa and cholera. In the skin the most striking exemplification of this effusion is seen in the vesication of an ordinary blister, in burns and scalds, and in the elevation of the cuticle which announces mortification.

Various names are employed to designate these effusions. When the fluid is poured out into the interstices of the sub-

cutaneous cellular tissue, it forms a smooth, pale, glossy swelling, which pits on pressure, and is seldom painful, unless there be considerable inflammation. This is called *œdema*. When this affection occurs in the extremities, it generally varies with the position of the body, being very slight or entirely absent when the limb is elevated, most prominent when it is dependent. The reason of this is obvious. In many cases the fluid is not developed in these parts, but gravitates thither from other regions, making passages for itself through the cellular tissue. As meaning the same thing, the term *anasarca* is sometimes used. The word, however, it should be observed, is generally employed in a more comprehensive sense, to designate the effusion of serum into the meshes of the cellular tissue, in whatever part of the body this structure exists. When the collections occur in the serous sacs, they are called *dropsies*. These, again, are named according to the particular cavities in which they are found. Thus, an accumulation of water in the arachnoid is denominated hydrocephalus ; in the spinal canal, hydrorachitis ; in the pleura, hydrothorax ; in the pericardium, hydropericardium ; in the peritonæum, hydroabdominalis ; in the vaginal tunic, hydrocele ; and hydrarthrosis in the articulations.

The color and consistence of this fluid are liable to considerable diversity. In some situations, as in the arachnoid membrane and subcutaneous cellular tissue, it is clear and limpid, like the purest spring water ; in others, it is more or less viscid, of a pale yellowish tint, and contains flakes of fibrin. A lemon-colored serum is not of infrequent occurrence in the chest, the vaginal tunic of the testicles, and in the articulations of the extremities. Occasionally the fluid is of a pale reddish color, from the admixture of hæmatosine, and cases are witnessed where it has the aspect and consistence of coffee-grounds. The latter variety is particularly common in inflammation of the peritonæum, caused by strangulation. In jaundice, it sometimes contains a yellow coloring matter, like that of the bile : it has also been found to be impregnated with cholesterine and uric acid.

Of the chemical composition of this fluid very little was known until within the last thirty years. For the most important information concerning it, we are principally indebted to Dr. Marcet, of England, to whom animal chemistry generally is under so many obligations. This distinguished physician has developed the interesting fact, that serous liquids,

no matter what may be the structure of the organ or tissue furnishing it, is essentially of the same nature. According to the statement which he has published in the second volume of the London Medico-Chirurgical Transactions, the prevailing animal substance is albumen, with a minute quantity of muco-extractive matter, which is uncoagulable, but soluble in water and other fluids. In none of his experiments did he detect any gelatine. The proportion of albumen is subject to much variety, being very abundant in some situations, and almost entirely wanting in others. The principal saline ingredients are soda and potash, in the form of muriates and sulphates, with phosphate of lime, iron, and magnesia. The specific gravity of the effused liquids is generally less than that of the serum of the blood, and their coagulability is always in direct ratio to the amount of albumen. In the fluid of hydrocephalus and spina bifida the quantity of this substance is frequently so small as scarcely to be rendered visible by heat, alcohol, or acids. From all, then, that we know concerning this matter, it may be legitimately inferred that it is perfectly identical with the serum of the blood from which it is derived, differing from it only in specific gravity, and in the relative proportion of its constituents.

The amount of fluid varies, under different circumstances, from a few drops to several gallons. The rapidity with which it is poured out, even in large quantity, is sometimes surprisingly great. In persons bit by venomous serpents, the whole body often attains an enormous size in the course of a few hours from this source, and some of the internal organs are literally inundated. Usually, however, the effusion takes place more gradually, and, as might be inferred from our previous remarks, never to any extent until the inflammation has attained a certain point. Let me be comprehended. In the serous membranes, which afford this fluid in greatest abundance, one of the first things that happens, when they are irritated, is the suspension of the natural secretion, which is restored and augmented only after the violence of the inflammatory impulse has somewhat abated. If this should not occur, lymph, not serum, will be furnished, either alone or combined with pus or blood; or the individual, the subject of the disease, will perish from its effects; or the part will fall into a state of sphaelus.

It has been already hinted that serous effusion is the result of inflammation, usually of a very mild grade. That this is

true, as a general rule, very few will attempt to dispute ; the exceptions, if there be any, are certainly very rare, and have not hitherto been satisfactorily pointed out. A few facts, clearly and concisely stated, will assist in determining this problem.

It has been alleged, in the first place, that serum is occasionally effused when there is an obstacle simply in the circulation, without any concomitant inflammatory action. It is a matter of common observation with the physician, that anasarca of the lower extremities often arises from obliteration of the femoral, external iliac, and ascending hollow vein ; and the face, neck, and arms are frequently loaded with serum from compression of the vessels whose duty it is to return the blood to the right side of the heart. When the portal vein, or any one of its principal branches, is obstructed, abdominal dropsy, or ascites, follows. Contraction of the right auriculo-ventricular orifice, or disease of the valves of the pulmonary artery, impeding the passage of the blood, and compelling it to regurgitate into the inferior cava, produces the same result, together with edema of the legs and feet. These examples will be sufficient for the subject which they are intended to illustrate. Let us now endeavor to ascertain how far they are dependent upon inflammation, or whether they are the result merely of mechanical obstruction ? It is frequently extremely difficult to ascertain the condition of the seat of the effusion by anatomical inspection. In ascites how often does it not happen that there is the most copious accumulation of water, caused obviously by inflammation ! and yet, on examination after death, there is scarcely a well-marked trace of the latter malady. That there are cases, then, of serous effusions, in which the ordinary phenomena of phlegmasia, particularly the discoloration, entirely vanish on the approach of death, or during the last struggles of life, cannot be doubted ; indeed, it is not improbable, I think, that there are instances in which this disposition occurs a long time before the individual expires. The absence of redness, therefore, does not prove that there was no inflammation ; for the existence of this lesion is sufficiently evinced by the presence of the watery accumulation, and the opacity of the affected membrane. Should there be, in addition, specks, patches, or bands of fibrin, all doubt on the subject must vanish.

Such, then, being the difficulty of recognizing the presence of inflammation, where every symptom during life gives in-

dubitable evidence of its existence, can it be wondered at that, in the instances above referred to, pathologists should still consider the effusion of serum as the result merely of mechanical obstruction? The question may now be asked, — can such an obstruction exist, to any considerable extent, without producing a state of parts analogous to, if not really identical with, inflammation? I would answer, no. Let it be supposed that the obstacle exists in the ascending hollow vein. This vessel is destined to return the blood from the inferior extremities, the pelvis and abdomen, to the right side of the heart. But, failing in the accomplishment of this object, from the difficulty adverted to, the blood is interrupted in its passage upwards, and congestion of all the vessels, both large and small, is the result. This congestion is not transient, but permanent; and it is scarcely reasonable to presume, judging from our knowledge of the circulation, that this state could exist long without producing an altered condition of the sensibility of the parts affected, attended with more or less redness, and effusion of serosity. The peritonæum and cellular tissue of the limbs are the structures which receive the brunt of the difficulty, and these are parts, it is well known, which are most liberally supplied with serous capillaries. But, it may be said that the effusion may result from perverted action, from irritation, or disturbed function: all this may be true, and yet not in the least invalidate our position. Every body knows that in inflammation there is perverted action, or deranged function, with irritation, or altered sensibility. These terms, therefore, if they mean any thing at all, only denote certain conditions — not the cause of these conditions; as redness, heat, pain, and turgescence are not inflammation, but only so many symptoms of it.

The preceding remarks are equally applicable to the watery effusions of the serous textures, which occur in association with organic diseases of the glandular and parenchymatous viscera. A large scirrrous tumor of the liver, seated so superficially as to encroach upon and fret its serous investment, is often attended with ascites, although the portal circulation is in no wise obstructed or embarrassed. In the same manner hydrothorax is sometimes induced by tubercles of the lungs; hydrocele by carcinoma of the testicle; hydrocephalus by heterologous growths of the brain. In all these instances the effusion of water is the result, unquestionably, of inflammation, lighted up in the serous covering of the respective

organs, by the morbid deposit acting in the capacity of a foreign substance. The dropsical accumulations which supervene upon scarlet fever, measles, and other eruptive diseases, can be traced, in most cases, directly to phlegmasial irritation of the serous membranes.

Taking into consideration the preceding facts, and the reasoning founded upon them, the conclusion is obvious that the effusion of serosity, no matter in what part, organ, or region it occurs, is the result, *invariably*, of a process analogous to, if not strictly identical with, inflammation. This process, we repeat, is often very imperfectly marked, both during life and after death, so that the ordinary phenomena of phlegmasia are in no way manifest to our senses. That this conclusion is fully borne out by the premises, is, I think, sufficiently evident ; and we shall, therefore, dismiss the subject, in the hope that what has been stated will have a tendency, at least, to arouse the attention of the profession to further investigation respecting it.

CHAPTER III.

*Of Lymphization.**

Always the result of Inflammation.—Physical properties of Lymph.—Quantity.—Varieties of Form.—Chemical Constitution.—Period at which the Deposition commences.—Has a tendency to become organized.—How this is effected.—Analogous Tissues.—Use of Lymph as a means of Restoration.—Adhesive Action.

IF there be still some doubt as to the question, whether effusion of serum is invariably of inflammatory origin, there can surely be none respecting that of fibrin. So true is this, in reference to the latter product, that it may be assumed as a law, than which there is none more satisfactorily established in pathological science. Yet, as in the former case, examples not unfrequently occur where the fibrin constitutes the only sign which is to be observed after death, of the previous existence of inflammation. In arachnitis, large quantities of this matter are often poured out, without our being able to detect the slightest redness, opacity, or thickening of the serous membrane. Nevertheless, would it not be the height of absurdity to say that, because any of the ordinary phenomena are wanting, there had been no inflammation? But we forbear making further comments on this topic, having dwelled upon it, at sufficient length, in the preceding pages. We only beg the reader to remember that the effusion of fibrin, gluten, or coagulating lymph, as it is variously termed, is uniformly the result of inflammation, and that it forms, occasionally, the only necroscopic sign which we have of the existence of this lesion.

With the appearance of this substance, every one is familiar. In the majority of instances, it is of a light opaline cast; in others, it is of a pale straw color, cineritious, of a

* As this term is not to be found in any of our pathological treatises, it is necessary to observe, that it is employed here in the same sense as "effusion of lymph" or "deposition of fibrin." We say a part is in a state of suppuration when it is secreting matter: with the same propriety we may say that a structure is in a state of lymphization, when it is pouring out lymph, gluten or fibrin.

milky white, or reddish, from the admixture of hæmatoxine. When first deposited, it is soft, fluid, and somewhat ropy, allowing itself to be drawn out into little filaments: after a while, however, as its watery particles are being removed, it assumes greater consistence, and is finally converted, in many cases, into firm, dense structure, having all the attributes of the cellular tissue, fibrous membrane, or even cartilage and bone. The period required for these transformations varies from a few weeks to as many months.

Lymph is effused under a considerable variety of *forms*, depending upon the peculiar shape of the part which supplies it. In the subcutaneous cellular tissue it usually occurs in small amorphous masses, sometimes in disseminated globules. In the larynx and trachea, it accurately moulds itself to those cavities. In the peritonæum, it forms bands, occasionally of considerable length, which extend from one coil of bowel to the other; and in the pleura it is commonly laminated. To these statements there are, of course, numerous exceptions, which will be particularly adverted to in a subsequent part of the present treatise.

The amount of fibrin poured out is subject to much diversity. As a general rule, it may be stated, that it is furnished most abundantly by the serous sacs; yet, under certain circumstances, large quantities are effused by the mucous membranes of the respiratory and intestinal tubes, as well as by that of the œsophagus and uterus. Happily, however, this substance rarely remains long in these outlets; otherwise the most serious consequences might ensue. As it is, in the trachea it often produces death, by preventing the ingress of the atmosphere; the lachrymal passages, and many of the minute bronchial canals are sometimes obliterated by it; in the urethra it lays the foundation of permanent stricture; and in the chest, by tying down and compressing the lungs, it has been known to give rise to atrophy, or otherwise embarrass the respiratory function.

Considerable quantities of fibrin are not unfrequently found on the inner surface of the arteries, and the largest sized trunks are occasionally obliterated by it. The muscles, fibrous membranes, the tendons, ligaments, cartilages, and bones yield very little when in a state of inflammation. The skin, the veins, and absorbents furnish it also very sparingly. A good deal is generally effused in phlegmasia of the subcutaneous cellular tissue, around abscesses, and upon

the walls of fistulous passages. With respect to the parenchymatous and glandular organs, the effusion of fibrin may be said to be in direct proportion to the amount of cellular substance which enters into their composition, being always very small where their structure is dense and compact, more or less copious where it is soft and lax.

The chemical composition of this substance, like that of serum, is essentially the same in whatever part of the body it is found. Professor Andral states that in the pleura and peritonæum it consists exclusively of fibrin: this, however, I presume, is an error, its constituents here as elsewhere being albumen and water, in union with the substance just mentioned. Immersed in alcohol, or a strong solution of corrosive sublimate, it becomes dense, firm, and assumes a whitish, shrivelled aspect. In water it is gradually decomposed, breaking up into small, dirty, rotten-looking fragments, which readily yield under the pressure of the finger. This substance, then, is identically the same with the buffy coat of the blood, being separated from the vessels by some secretory process, which rejects the coloring and saline principles of that fluid, whilst it permits others to escape along with it.

The period at which the deposition of lymph commences is influenced by different circumstances, the principal of which are referable to the intensity of the inflammation and the nature of the affected structure, tissue, or organ. In some experiments which Dr. Thomson, of Edinburgh, made on the inferior animals, a distinct layer of lymph was seen covering the incisions within less than four hours after they had been inflicted; * and in a young man who died last summer of a gun-shot wound, which penetrated the liver and diaphragm, I found both the pleura and peritonæum extensively coated with this substance, nine hours after the reception of the injury. In many cases there is reason to believe that the effusion in question takes place almost at the very onset of the inflammation, and proceeds with greater or less rapidity until the disease either abates, passes into suppuration, assumes achronic form, or destroys the life of the individual.

If this substance be allowed to remain undisturbed, it manifests a disposition, sooner or later, to become organized. The period at which this occurs varies from a few hours to sev-

* Lectures on Inflammation, p. 168. Phila. 1831.

eral weeks : in some instances, indeed, it never takes place at all. The serous sacs are the situations in which the process is accomplished with the greatest ease and rapidity, whilst the mucous membranes are parts in which, if it happen at all, it is effected very imperfectly, and only after a long period. It likewise takes place with much facility in the skin, cellular tissue, and bones, after injuries.

How this organization is brought about, is an interesting subject of inquiry, and one which has excited much discussion among pathological anatomists. That it is effected in one of two ways, is sufficiently obvious,—either by the vessels of the natural tissues shooting into it, or spontaneously by powers residing within itself. Proofs are not wanting in support of both views. In removing, for example, a recently formed adventitious membrane, we not unfrequently find that its adherent surface is marked by numerous bloody points, caused evidently by the rupture of the elongated capillaries of the inflamed normal membrane. What renders this supposition more probable, is the fact that the free surface of the serous membrane — for it is to this class of textures that these remarks are more particularly intended to apply — is studded with very minute granulations, which are highly vascular, and accurately correspond in their situation with the red dots observable on the attached surface of the new membrane. In process of time, these granulations become more and more distinct, both on the original and on the adventitious structure ; and, by means of a magnifying-glass, very delicate slender vessels, arterial as well as venous, may be seen passing from the substance of the one into that of the other. As the penetrating vessels increase in volume and number, the lymph adheres more firmly to the inflamed surface of the natural membrane, until at length the circulation between them is fully established, being carried on with the same freedom and vigor as in other regions of the body.

The second opinion — that, namely, which supposes the lymph to possess a self-organizing power — ranks amongst its advocates some of the most distinguished pathologists of the last and present centuries : and the facts which they have adduced in favor of their position go far, it must be confessed, in leading us to doubt whether this substance, in whatever form it may appear, is ever vitalized in any other way. They have shown, most conclusively, as it seems to me, that portions of exuded lymph contain vessels, and perform the func-

tions of nutrition, secretion, and absorption, before it is possible to trace the slightest vascular connection between them and the surrounding textures. In the pleura, it has often occurred to me to see as many as three, four, five, and even six distinct layers of this substance, arranged so as to intercept cavities of various sizes, filled with serum, flakes of fibrin, pus, or even blood. In some of the cases, the circumstances were such as to render it perfectly certain, that the developement of these adventitious membranes must have taken place with so much rapidity as to preclude the idea that their organization could be effected through the agency of the subjacent serous structure. There is therefore reason to believe, that lymph possesses, in many instances, an inherent self-creating power, in virtue of which it forms blood which gradually prepares its own vessels. What the precise nature of this vitalizing influence is, we cannot, of course, determine: the difficulty, surely, cannot be solved by invoking the agency of the electric fluid, as has been done by Andral. Of the intimate character of this fluid we know as little as of life itself; and the notion just alluded to is therefore ill calculated to enlighten us on a subject concerning which we must necessarily remain forever ignorant.

The primordial traces of the organizing process consist, according to the theory under consideration, in the appearance of a few red dots, which have been happily compared to the "salient point" in the vitelline membrane of the chick, — the fibrin being endowed, as was before stated, with a similar property of generating blood.* Red furrows, streaks, or lines, are sometimes perceived, shooting out in various directions, which gradually assume the character of distinct vessels, in every respect analogous to those in other parts of the body. In other cases the small sanguineous trains take on a ramiform arrangement, and are ultimately converted into real vascular tubes. Examined at an early period of their developement, the trains here adverted to are found, according to Laennec, who has carefully described them, to contain minute filaments of fibrin, permeable at their centre, which soon assume a cylindrical shape, and thus constitute the rudiments of the future vessels. These new channels, composed both of arteries and veins, the latter of which, however, predominate as well in volume

* Dr. Adair Crawford, Cyclop. Pract. Medicine, art. *Inflammation*, p. 765.

as in number, gradually extend towards the neighboring parts, with the capillaries of which they finally inosculate, the blood passing freely from the one to the other. It should be observed that, in their mode of arrangement, many of these vessels resemble the *vena porta*; that is to say, they consist each of a single trunk, usually of considerable length, from each extremity of which are detached a certain number of branches, twigs, and filaments.

Such is an abstract,—too rapid and imperfect an one, I fear, to do justice to the subject,—of those two principal theories that have been advanced in relation to the manner in which this substance is organized, and rendered “part and parcel” of the living system. Both of them are highly plausible and ingenious, and both of them are, perhaps, equally entitled to our confidence and regard. The probability is that neither the one nor the other is exclusively applicable to all cases. To be at all susceptible of organization, it is necessary that the lymph at the time of its deposition should be endowed with a certain amount of vitality; for where this is withheld, it will soon be broken down and converted into puriform matter. When, therefore, the exudation is very feebly vitalized at the moment of its secretion, it may be inferred that it can become organized only by the vessels of the surrounding textures sprouting into it; whilst, on the other hand, if it be highly impregnated, if I may so express myself, with the living principle, it may be supposed to be capable of effecting this object by its own inherent powers, without any assistance whatever from the original structures. Be this as it may, it is impossible to avoid the conclusion that coagulating lymph is susceptible of spontaneous organization. Independently of the facts already adduced, the experiments of John Hunter and Everard Home, in which the vessels formed in a clot of blood were successfully filled with injecting matter, place this subject in a most incontrovertible light.

Nothing is known, with any certainty, concerning the *nerves* of this organized matter. So far as my knowledge extends, I am not aware that any anatomist has succeeded in detecting these structures in the adventitious membranes, that they exist, however, may be legitimately inferred from the fact that they are capable of executing the highly important function of nutrition, secretion, and absorption, which, but for this circumstance, they could not possibly accomplish.

My own opinion is, that plastic lymph, in whatever part of the body it may occur, in its progress towards organization, either generates its own nerves, or receives them from the neighboring tissues, in the coats of the vessels. I am the more inclined to adopt this view from the analogy afforded by some of the primitive textures, as the osseous and cartilaginous, which, there is every reason to believe, obtain their nervous supply in this way. Absorbent vessels also probably exist, and, as I should suppose, in great numbers. Their presence, however, like that of the nerves, is a matter merely of inference, not of actual observation, which has hitherto failed in detecting them.

Whether the plastic lymph, when once organized, remains during life, or whether it is partially or totally absorbed, are points respecting which there still exists a difference of opinion. Most generally it maintains its parasitic existence, though occasionally there is just ground for believing that it disappears. This, at least, would seem to have occurred in the interesting case of a maniac, dissected by the late Professor Beclard, of Paris. In some of his paroxysms, this individual inflicted upon himself a considerable number of stabs, several of which penetrated the abdomen. In the most recent, the intestine adhered directly to the wounded spots; in another, evidently of longer standing, the union was effected by a small, narrow band; whilst in that which was inflicted first, the bridle was absorbed at the middle, and thereby broken.*

Plastic lymph, organized in the manner now described, forms the basis of all the analogous tissues, and the bond of union of divided parts. It may become the seat of inflammation, both acute and chronic; pour out serum, lymph, pus, or even blood; and undergo various transformations precisely in the same manner as any of the natural textures. It should also be remarked here, that this substance is the source of what is termed indurations, and probably, also, of scirrhus and tubercle.

The *analogous tissues* formed, as I have just stated, out of the plastic element of the blood, are nearly as numerous as the natural, to which, as their name imports, they bear the closest resemblance in the threefold respect of physical,

* General Anatomy, by Dr. Togno, p. 156.

chemical, and vital properties. The following arrangement includes the different kinds of textures pertaining to this class which have hitherto been described by authors: Cellular; serous; mucous; cutaneous; vascular, including the erectile; adipous; horny, including the cuticle, hair, and nails; fibrous; fibro-cartilaginous; cartilaginous; osseous. These tissues will be described in their appropriate places. In the mean time, it may be remarked concerning them, generally, that they do not occur with equal facility; that they are more prone to arise in old people than in the young; and that whilst some most closely resemble the tissues from which they have received their names, the likeness of others is faint and imperfect.

It has been already intimated that coagulating lymph performs a most conspicuous part in the reunion of divided parts. Without the assistance of this substance, no wound, however trifling, could possibly get well. The little incision made in the operation of venesection would either prove fatal, or become a source of permanent inconvenience and suffering. Ulcers would not heal, and fractured limbs would dangle about "in wild uncertainty." Formerly surgeons seemed to be entirely ignorant of the utility of this substance as a means of repairing injuries, whether occurring in the soft or in the hard parts of the body. It remained for Mr. Hunter to exhibit the subject in its true light, by which he created an epoch in the history of our science, amongst the most interesting that have occurred.

As admitting of the most easy examination, the attention of the reader may be here directed for a few moments to the part which this substance performs in the reparation of wounds of the cutaneous and cellular tissues. If these structures be simply incised, the edges of the cut surface, if kept in close apposition with each other, are united by what was formerly denominated *first intention*, or, since the time of John Hunter, union by *adhesive inflammation*. In a case of this description, the first thing that nature does is to set up a new action in the part; that is, the wound becomes red, painful, hot, and tumid,—phenomena which clearly indicate that her workmen are busily engaged in repairing the injury which has been sustained. Plastic lymph is now thrown out, by which the contiguous surfaces of the incision are gradually and effectually agglutinated together. Whilst this secretion is in

operation, the vessels of the part are elongated, and, passing through the bond of union thus set up, they finally inosculate with each other, transmitting thereby the blood through the new substance, which, at the same time, increases considerably in firmness and density. Similar changes take place with respect to the nerves and absorbents. Thus the lymph that is poured out becomes a living intermedium ; and it is in this way that the restoration of divided parts, no matter what may be their structure, is effected. It should be observed, however, that in order that the process may go on kindly, the concomitant inflammation should not transcend certain limits ; for, where this happens, purulent matter will be effused, not fibrin. This, then, is a point which should always be guarded against by the judicious surgeon.

It is upon a knowledge of this property of coagulating lymph, that are founded some of the most astonishing improvements that have been achieved by modern surgery. Amongst these the most remarkable are the operations for tying arteries, in cases of aneurism, so much perfected, if not devised, by John Hunter ; and for repairing mutilated organs by transplanting parts from one region of the body to the other. Much good has also resulted in respect to the treatment of incised wounds, whether produced by accident, by the removal of a tumor, or the amputation of a limb. In all these instances it is customary, in every part of the civilized world, with the exception, perhaps, of France, to endeavor, if possible, to bring about union by the first intention ; the surgeon well knowing that if this can be effected he will save himself much trouble, and the patient no little suffering and inconvenience. When we reflect upon this subject, it is extremely difficult to account for the great apathy and silly hesitancy which the Parisian practitioners exhibit, with regard to this plan of treatment, about the propriety of which there ought to be but one opinion. In this respect they certainly are fifty years behind the present state of the science, — a circumstance which is so much the more surprising, when it is recollected that they have decidedly the best schools of pathology in the world.

The effusion of lymph is a means which nature sometimes employs to obviate accidents. A striking exemplification of this conservative process is witnessed in cases of tubercular plithisis. In this disease, abscesses generally form in the

superior lobes of the lungs: these are sometimes seated quite superficially; at other times they are exceedingly capacious, and extend their dimensions until they make their way completely through the pulmonary tissue, and even the pleura. But does the softened tubercular matter usually escape? By no means. Long before the event alluded to takes place, inflammation is set up in the surrounding serous membranes, followed by a copious secretion of lymph, by which a barrier is formed that effectually opposes the extravasation of the contents of the cavity. Similar phenomena occur in ulcerations of the bowels, and in abscesses of the abdominal and pelvic viscera.

CHAPTER IV.

Of Suppuration.

Definition.—Organs in which it is most easily effected.—May take place without Solution of Continuity.—Varieties of Form.—Abscesses.—Physical and Chemical Properties of Pus.—Distinguishing Tests.—How produced.

A THIRD mode by which inflammation relieves itself is by suppuration. This consists in the formation of purulent matter, and constitutes, strictly speaking, merely the third stage of inflammation, inasmuch as pus is never developed when there is an entire absence of this state. That this position is correct, no one at all acquainted with the subject will doubt. Mr. Hunter, it is true, is of opinion that collections of extraneous matter, as he terms them, may form in various parts of the body, without being preceded by inflammation; but in this notion he has not been followed, so far as I know, by any respectable authority since he promulgated it. This idea, that pus might be formed without previous inflammation, originated, it would appear, with De Haen, a celebrated German physician. He uses the term inflammation as synonymous with ulcerative absorption. Indeed, if any one will take the trouble to peruse the chapter which this great pathologist has published on this subject, he will be struck, at almost every line, with the vagueness of his expressions and the inconclusiveness of his reasonings. In what is called a cold abscess, the formation of which is sometimes the work of months, inflammation has just as much to do as in a phlegmonous boil that is developed in two or three days. The only difference is, that, in the one the process goes on slowly, almost imperceptibly; whereas in the other it proceeds rapidly, and is accompanied with symptoms so well marked as not to be mistaken by the most superficial observer. But to discuss this topic at any length at the present day, when every thing relating to it is fully admitted, might justly be considered a matter of supererogation; and I will therefore conclude this branch of the subject by laying down the

proposition, that *the formation of pus, in whatever part of the body occurring, is the result of inflammatory action, either acute or chronic, simple or specific.*

The formation of purulent matter does not take place with equal facility in all the organs and textures. Of the viscera, those which are most prone to take on suppurative action are the liver, lungs, and brain; of the tissues, the cellular, the cutaneous, mucous, and serous. In the fibrous textures, the cartilaginous, tendinous, and osseous matter forms with difficulty, and is seldom of a thick, consistent nature. Of the mucous system some portions are more liable to be affected with suppuration than others. Thus, it is much more common to find pus in the colon than in the stomach or ileum, in the vagina than in the uterus, in the urethra than in the urinary bladder, in the nose than in the mouth, in the fauces than in the œsophagus, in the bronchia than in the larynx. So, likewise, in the serous system, suppuration is more frequent in some situations than in others; as, for example, in the pleura, the vaginal tunic of the testicle, and the lining membrane of the larger joints. In the subcutaneous cellular texture, pus is most readily formed in parts which are remote from the central organ of the circulation. The blood-vessels do not often suppurate, except when they are wounded; and the same, so far as we know, is the case with the absorbents. The lymphatic ganglions, however, are very frequently affected in this way, especially those of the axilla, the groin, the mesentery, and at the base of the lower-jaw, in persons who are predisposed to scrofulous disease. The nervous tissue seldom suppurates, and still more rarely the osseous and the muscular. From all these facts we may deduce this axiom, that those structures are most prone to form matter which contain the largest amount of loose cellular substance, and, conversely, that those which possess this tissue sparingly always suppurate with difficulty, requiring in general a much longer period, and elaborating a less perfect fluid.

It is a singular circumstance that pus may be formed without any solution of continuity. We owe to Mr. John Hunter the suggestion of this fact, which, as he states, first occurred to him soon after the middle of the last century, in examining the body of a young man who died of disease of the pleura. It need scarcely be observed that this mode of suppuration is a very common one, not only in all the serous cavities, but throughout nearly the whole of the mucous system. Nor is

it confined to these textures. In the cellular substance, in the lungs, brain, liver, and other viscera, nothing is more frequent than suppuration, without any breach whatever, in the first instance, of continuity.

Pus, when first effused, generally appears in the form of distinct globules, which are dispersed through the affected structure, and can be easily recognized by their pale yellowish color. As the purulent particles increase in number, they gradually become confluent by the absorption of the part concerned, and in this way the matter is at length collected into an abscess. The time required for the formation of an abscess depends a good deal upon the constitution of the patient, the nature of the exciting cause, and the anatomical elements of the various organs. In the lungs, brain, spinal cord, and spleen, death usually takes place before the matter is allowed to concentrate itself into a focus, and hence, in examining subjects who die of acute diseases of these viscera, it is extremely rare to meet with an abscess, even of small size. On an average, the period necessary for the formation of visceral collections of this kind may be stated at fifteen days; whereas, in the subcutaneous cellular substance, abscesses often make their appearance in less than a week,—sometimes, indeed, in less than forty-eight hours from the commencement of the inflammation.

Superficial abscesses have always a tendency to work their way to the surface: such, on the contrary, as are deep seated, discharge their contents into some hollow viscus, burst into a splanchnic cavity, or they become lined with a layer of coagulating lymph. This substance, which is poured out by the neighboring vessels, is of a pale, cineritious color, and is arranged so as to form a distinct *cyst*, *sac*, or *bag*, by which the matter is effectually prevented from diffusing itself through the surrounding parts. In process of time the membrane that is thus developed, becomes organized, and in abscesses of long standing it often acquires considerable thickness, say from two lines to half an inch. Internally it is either perfectly smooth, or, as more frequently happens, villous, or granulated; externally it is rough, flocculent, and firmly united to the neighboring textures, which are at the same time preternaturally dense and vascular, from the presence of inflammatory irritation. The *cyst*, it may now be observed, is both a secreting and an absorbing texture, resembling, in this respect, the organized adventitious membranes of the serous cavities described in a preceding page.

Abscesses, whether encysted or not, present much variety with respect to their size. As a general rule, it may be stated, that their dimensions are in direct ratio to the spongy structure of the affected part. Thus, abscesses of the glandular organs are seldom so large as those that are developed in the groin, the axilla, the lumbar region, and in the retro-peritoneal cellular substance, where they not unfrequently attain a magnitude capable of holding many quarts of pus. Not less variable is their number. Whilst in some cases there is only one, in others, as, for example, in the liver, there are as many as twenty, forty, or even fifty.

This subject necessarily brings us to the consideration of the physical and chemical properties of pus. When genuine, or, as it is not improperly termed, healthy, pus is of a pale yellowish tint, opake, nearly of the consistence of cream, of a sweetish taste, without any particular smell, and of the specific gravity of 1050. Being neither alkaline nor acid, it does not affect vegetable colors until it has been for some time exposed to the air, when it becomes slightly sour. It readily combines with water, which, when pure, it uniformly whitens, emits a faint mawkish odor on being heated to the normal temperature of the body, resists putrifaction for a long time, and is coagulated by heat, alcohol, and muriate of ammonia. When examined with the microscope, it appears to be composed of a prodigious number of globules suspended in a thin transparent fluid, which has been found, on analysis, to consist of albumen, fibrin, extractive and fatty matter, muriate of soda, phosphate of lime, and other salts. Examined by the eye, this liquid has all the appearances of the serum of the blood, but differs from it by a peculiar state of the albumen and of the extractive matter just referred to. The globules, which are of a spherical figure, and of a light yellowish tint, are the two thousandth part of an inch in diameter, or about a third larger than those of the blood.

When matter possesses the foregoing characters, it is said, in surgical language, to be *healthy*, in reference to the process by which it is produced, which, it is supposed, is of a sanative nature. If it be thin, watery, and sanguinolent, it is termed *sanious* pus; if thick and curdy, *scrofulous* pus; if firm and concrete, *lymphy* pus. Sanious matter is generally of an irritating nature, producing not unfrequently erosion of the parts with which it comes in contact: it contains a superabundance of salts and albumen, together with red particles,

is often quite offensive, and is observed principally in suppuration of the cutaneous and osseous textures. Scrofulous pus is mostly seen in tubercular disease of the lungs, and in chronic inflammation of the lymphatic ganglions: granules of calcerous matter are occasionally blended with it; and if it be allowed to remain at rest for a short time it usually separates into two parts, — the one being thick, straw-colored, and inodorous; the other thin, ropy, and mixed with small, opaque, cheesy flakes. When scrofulous pus is long retained, it has been known to be excessively foetid, from the extrication, probably, of sulphuretted hydrogen gas.

Various attempts have been made by writers, with the hope of discovering some test by which pus might be distinguished from other secretions, especially from mucus, which it is known to resemble more closely than any other. From some experiments performed by Mr. John Hunter, he was induced to recommend the muriate of ammonia, which, as we have seen, readily coagulates the fluid in question, whilst no such effect is produced on blood or mucus. The younger Darwin proposed a double test of sulphuric acid, and a solution of pure potash. If, on the addition of water to pus dissolved in either of these liquids separately, there be a copious precipitate, the matter made use of is judged to be purulent; but, if there be no such deposit, it must, as is alleged, be of some other character. But the most unexceptionable test, perhaps, is that which was suggested by the late learned Dr. Young, of England. It is founded on the globular particles of the pus, and consists simply in holding a small quantity of this fluid, placed between two thin pieces of glass, between the eye and a candle, a little way off. If the matter be purulent, it will be encompassed by a bright halo of colors, not unlike those of the rainbow, the light being at the centre, and the tints so much the more intense as the particles are more numerous and more equably diffused.*

Concerning the mode of production of this fluid, pathologists have expressed very different views. Boerhaave and some of his followers attributed the formation of pus to a dissolution of the solids; Pringle and Gaber, to putrifaction of the serum; Gorter and Quesnai, to changes induced in the coagulating lymph. But all these singular notions, with many others, have been fully refuted, or deemed unworthy of

* Young's Medical Literature, p. 574.

this trouble. The first consistent theory on this subject was advanced by Dr. Morgan, of Philadelphia, in his inaugural dissertation published at Edinburgh, in 1763. In this tract, he threw out the hint that pus is a peculiar morbid secretion, which is always preceded and accompanied by inflammation of the affected part ; and a somewhat similar view was shortly afterwards adopted by Mr. Hudson, of England. The way which was thus prepared by these and other writers, was subsequently more successfully explored by John Hunter. It remained for the penetrating genius of this great man — great in every thing which he attempted — to remove the flimsy veil which still shrouded this curious process, and to place it in a light at once so clear and conspicuous, that very little has been added to the subject since the time in which he wrote. Pus, then, is not produced, as was contended by the older authors, by a breaking down of the solids, or by changes wrought in the serum or fibrin, but by a peculiar secretion, not unlike that in kind, though more intense in degree, which is concerned in separating the nutritious particles from the vital fluid.

That pus itself is merely an altered state of the blood, seems to be equally true, more especially when it is remembered that it includes all the essential ingredients of that fluid. How it is deprived of the coloring matter, it is not easy to determine ; it is one of those hidden and mysterious circumstances, the efficient cause of which is locked up in the bosom of the Creator, and concerning which it would be absurd to speculate. If any reliance is to be placed in the well-conducted observations of Gendrin, it must be concluded that the formation of pus bears a very great analogy to the separation of the serum or fibrin. On inspecting the capillaries of a frog's foot, which had been for some time in a state of inflammation, this distinguished philosopher states that he repeatedly observed the changes which the globules of the blood undergo preparatory to their conversion into pus. At first, the minute vessels are merely dilated from excessive sanguineous engorgement ; but, in the course of a few days, sooner or later, according to the nature of the exciting cause, the circulation becomes remarkably tardy, and they are then seen to be distended with a pale grayish fluid, inclining somewhat to yellow. In its character, this fluid is essentially globular, the particles of which it consists being considerably larger than those of healthy blood, and differing

in their aspect according to the degree of the metamorphosis which they have experienced. Thus, at the centre of the inflamed part, they are of the color of cream, a little farther on, of a grayish appearance, whilst towards the periphery, where the elaboration is still very imperfect, they are partly red, and partly yellow, with various intermediate shades which are more easily perceived than described.

A similar effect ensues, says Gendrin, in the coagulum which is formed subsequently to the tying of an artery. If a ligature be placed round the vessel above the obliteration, and a seton be passed through the clot, suppuration is observed in a short time to occur, the inspissated blood becoming gradually softened, and converted into purulent matter, in the same manner as in an inflamed tissue.* These and other observations, which we have not room to dwell upon, conclusively show that pus is directly derived from the blood, by a peculiar process, which may be considered as a degree higher than that which is concerned in the separation of coagulating lymph.†

* *Histoire Anatomique des Inflammations*, t. ii. p. 471.

† “Il n'y a donc,” says Gendrin; “entre le fluide purulent des tissus enflammés et le fluide coagulable organisable qu'un degré de plus.” Op. Cit. This remark is very similar to one made long before by Mr. John Hunter. His language is substantially this, — *that the new-formed matter peculiar to suppuration is a remove further from the nature of the blood than the matter formed by adhesive inflammation.* See his excellent chapter on suppuration, in his work on the Blood.

CHAPTER V.

Of Hemorrhage.

The subject still involved in obscurity.—Causes.—Opinions of Morgagni and of Bichat; Exhalant Vessels.—Apitude of different Structures.—Nomenclature.—Predisposition.—Hereditary Proclivity.—Hemorrhage sometimes virarious — Active and passive.—Critical.—Quantity of Blood effused.—Changes and final Disposition.

In the pathology of hemorrhage there is much that yet remains to be elucidated. This is not surprising, when we consider the ignorance which still exists in relation to the capillaries in which this lesion is, for the most part, located. We have no means, except by analogy and induction, of ascertaining the habits, if I may so express myself, of these small tubes whilst engaged in the discharge of their various functions. We are acquainted, however, with certain facts, and these, scanty as they are, must guide us in the discussion of the subject.

Although inflammation is not unfrequently attended by a discharge of blood, this is by no means the only condition in which this phenomenon is observed. In many instances it would seem to be the result purely of over distention of the capillaries, from obstruction in the heart or large vessels, by which the sanguine fluid is prevented from pursuing its accustomed route with its accustomed freedom. Nor is it necessary, in order to bring about this congestion, that the system should be in a state of plethora: most commonly, indeed, the reverse is the case, the quantity of blood being unusually small. In some diseases, again, such as scurvy and typhus, in which hemorrhagic effusions are by no means infrequent, it is exceedingly probable that the blood itself is morbidly affected, by which it is enabled the more readily to percolate through the relaxed parietes of the minute vessels, carrying with it its different component elements.

Formerly the idea prevailed that all sanguineous effusions depended invariably upon a rupture of the blood-vessels. Nor is this notion, even at the present day, fully eradicated from the

minds of some physicians and pathologists. Morgagni seems to have been the first to throw out the hint that hemorrhages might be the result merely of a process of exhalation, without the slightest appreciable lesion of the vessels from which it emanates. This opinion, so well calculated to elucidate this interesting piece of pathology, was afterwards embraced by Xavier Bichat, who has fully discussed it in his great work on the tissues. He explains the phenomenon through the instrumentality of a set of open-mouthed vessels, known under the name of the *exhalants*. Of these he has described not less than three distinct orders, the excrementitious, nutrient, and recrementitious. The existence of such vessels was long ago admitted by Boerhaave and Haller; and, since their time, they have formed a favorite subject of speculation with many highly respectable anatomists. Unfortunately, however, much labor has been wasted which might have been turned to more profitable account; for it is now well known that there are no exhalants, in the true sense of that term; none, at all events, have ever been demonstrated, and probably never will be.

How, then, if the open-mouthed vessels, so minutely described by Bichat and others, have no existence, are we to explain the exhalation of blood? Are we to suppose, with Mascagni, that the arteries are every where furnished with pores through which the contained fluids merely percolate? That there are apertures in the tunics of the vessels, of some kind or other, is a circumstance concerning which there can no longer be any dispute. The experiments of Dutrochet, of France, repeated and modified by our countrymen, Dr. John K. Mitchell, of Philadelphia,* and Dr. Edwin D. Faust, of South Carolina,† satisfactorily prove that all animal tissues are permeable to fluids and gases; which could not be the case if they were destitute of pores. What the nature of these openings is, it is not my design to inquire, nor is it important that it should be known. The fact that they exist is sufficient for my purpose.

Assuming, therefore, that all vessels are porous, the most plausible theory that suggests itself is, that all hemorrhages, not dependent on rupture, are caused by a sort of exosmose,

* On the Penetrativeness of Fluids. American Journal of the Med. Sciences, vol. vii. p. 36.

† Experiments and Observations on the Endosmose and Exosmose of Gases, ib. vol. vii. p. 23.

diapedesis, or transudation, by which the elements of the blood are forced through the coats of the vessels, and made to occupy situations, in which they are not naturally found. How far this process differs from that of ordinary secretion, or what the precise conditions are on which it depends, are circumstances which it is not in our power to explain. Analogically, it may be inferred that the vessels are in a state of morbid activity, whereby fluids are suffered to escape, that were appointed to be retained; or it may be supposed, as we have reason to believe is often actually the case, that the capillaries, being in a state of debility and relaxation, their pores are rendered unnaturally patent, and thus allow the blood to have a more ready egress. Nor is it probable that the change, whatever it may be, is confined to the minute vessels. To give rise to the phenomenon in question, the nervous system must be involved, by which, if it do not excite, it promotes and countenances, the perverted action. The idea of Morgagni and Bichat, that hemorrhage proceeds from exhalation, embraces no error, further than that it ascribes this process to a set of vessels which, so far as is at present known, have no real existence. In all other respects, the term exhalation expresses the same thing as that of exosmose, transudation, oozing, or diapedesis.

The theory propounded by Morgagni and Bichat will not appear so difficult, if we take into account the results of some recent experiments in relation to the subject of venous absorption. The doctrine that this function is exclusively executed by the lymphatics, has been completely subverted by the researches of Magendie and other physiologists. If, then, it be admitted, as certainly it must, that the veins absorb or imbibe fluids, it does not require much stretch of imagination to conceive that the arteries, which so much resemble them in structure, should exhale blood, especially when they are in a state of disease. This process, indeed, takes place, apparently, even within the limits of health, as in the uterus, where it constitutes the menses.

How far hemorrhage, not dependent upon rupture, is connected with inflammation, is a question, for the solution of which we have no accurate data. That mere congestion will produce this result, has been sufficiently established by experiments on the inferior animals. Boerhaave excited hemorrhage in the intestinal mucous membrane of dogs, by placing a ligature on the portal vein; and similar effects have

since been produced by tying the vessels of the stomach, spleen, and other organs. Nevertheless, it is doubtful, even in these instances, whether the parts from which the blood flowed were not in a state approximating to, if not identical with, inflammation, as characterized in its earlier stages. As affording analogical evidence, we may here refer to the phenomena which take place in the uterus. After the period of puberty, it is the duty of this organ, at every lunar month, to elaborate a fluid, which, in every respect, resembles pure blood, save that it has a stronger odor, and does not coagulate. The discharge that is thus set up is a natural one, as it is common to all women; yet how comparatively few are there who do not experience more or less constitutional derangement during its existence? Many, indeed, undergo great suffering, laboring under all the symptoms which indicate the presence of inflammation. Taking into connection, therefore, these and similar facts, it is extremely difficult, I say, in many cases, to determine how far the exhalation of blood is concerned with, or independent of, inflammation. The relationship, so far as it goes, can only be ascertained by further observations and experiments.

Having made these remarks, it may now be stated that, so far as the *immediate* causes of hemorrhage are concerned, they may result, first, from exhalation; and, secondly, from direct injury of the vessels. In regard to the former of these divisions, enough has been said to render it unnecessary to add any thing more in this place; as respects the latter, I shall only observe, that the most frequent source of hemorrhage is a rupture of the vessels, in consequence of disease of their tunics, or from the violence with which the blood is impelled into them by the action of the heart or by extraneous force.

The structures in which hemorrhage is most frequently observed, are the mucous, the cellular, and the serous. Every organ and texture of the body, however, is liable to be thus affected. Concerning the mucous system, it may be remarked that some portions are much oftener involved than others. It is asserted by some, that all parts of the alimentary tube are equally subject to this effusion, which, however, is a mistake. Beyond all doubt hemorrhage is most common in the large bowel; next, in point of frequency, it occurs in the stomach; and, finally, in the inferior third of the ileum. The jejunum and duodenum, together with the œsophagus, mouth, and

fauces, are rarely affected. A discharge of blood from the nose and bronchial tubes is not an infrequent event, whereas it is very unusual in the larynx and the trachea. In regard to the genito-urinary division of the mucous system, considerable difference obtains in the two sexes. In the male, the urethra and bladder are oftener involved ; in the female, the uterus and vagina.

Of the serous membranes, the parts most liable to sanguineous effusion are the pleura and pericardium. The cutaneous texture is very rarely affected, except in scurvy and typhus fever. With regard to the viscera, the brain and lungs are much oftener the seat of hemorrhage than any other. Indeed, it is doubtful whether some of them, owing to the peculiarity of their structure, are susceptible of this lesion. Be this as it may, effusions of blood, whether from rupture or otherwise, are exceedingly uncommon in the liver, spleen, kidney, pancreas, uterus, and other organs. In the fibrous, cartilaginous, ligamentous, and osseous textures, they seldom, if ever, occur.

Eruptions of blood have received different names, according to the parts in which they occur ; but these it is not necessary to specify. This lesion, it may also be stated, is sometimes described under the term *apoplexy*. This word was originally restricted to hemorrhagic effusions in the brain : at the present period, however, it is employed in a wider sense, being applied to all extravasations of blood, no matter where occurring.

The predisposition to hemorrhage to different organs varies remarkably in the different periods of life. During childhood expistaxis is most common ; between twenty and thirty-five, there is an extraordinary proclivity to hemorrhage of the lungs and of the rectum ; about the age of forty, bleeding of the uterus is most usual ; from fifty to sixty, apoplexy and hematuria are most frequent, especially in men of irregular, dissolute habits. The exciting causes of hemorrhage are extremely numerous, but as they do not particularly concern the pathological anatomist, they need not be enumerated in this place. A plethoric state of the system, especially in the young, and a nervo-sanguineous temperament, are circumstances which powerfully predispose to its occurrence. Climate also appears to determine some difference in the eruption of blood in different situations. In cold regions, for example, hemorrhage is most frequently observed in the nose,

bronchial tubes, and urinary bladder; in tropical, in the rectum and uterus. On the whole, it may be said, also, to be more common in the female than in the male; though, as respects this point, we have no positive facts from which to deduce any just conclusion.

One of the most remarkable circumstances in the history of this lesion, is its hereditary tendency. The facts which are in our possession, in relation to this subject, are too numerous and well authenticated to admit of the slightest doubt, in the mind even of the most skeptical. Almost every practitioner must have noticed cases of this description. Dr. Kriener, a German physiologist, records a curious instance in which this hereditary proclivity displayed itself in the male descendants of a family in four successive generations; and two similar cases have recently been reported by Dr. J. N. Hughes, of the State of Kentucky.* What is more singular than all, is, that the disease may cease in one generation and reappear in another. In a most remarkable case of this mode of transmission, mentioned by Dr. Riecken, the parents, who both attained to old age, had never been subject to hemorrhage. The couple had twelve children — five boys and seven girls — of whom three of the former and one of the latter died of the lesion in question. The youngest daughter, who never suffered from the affection, married a stout, healthy man, by whom she had six children — four boys and two girls — two of the former of whom fell victims to hemorrhage.†

Not less singular is that variety of hemorrhage to which the term *vicarious* has been applied. As its name imports, it is supplemental of a similar natural or morbid state in a remote organ, and is most frequently observed in young females, in consequence of the tardy appearance of the menstrual flux, or from its suppression after it has been established. In the great majority of cases, it is located in the mucous membrane of the nose, and recurs with considerable regularity every lunar month, until the difficulty, of which it is the result, has subsided. Occasionally the blood oozes from the skin, the eye, ear, lung, anus, and even the nipple, either simultaneously or successively. What particular

* Transylvania Journal of Medicine, vols. iv. and v.

† Edinburgh Medical and Surgical Journal, No. 103; also, Cyclop. Pract. Medicine, vol. ii. p. 480.

changes, if any, the capillaries, which are the seat of these vicarious effusions, undergo, is not ascertained: we only know that they are the chief agents which are concerned in their production: beyond this all is doubt and uncertainty. That they are effected under the immediate influence of the functional operation of the minute vessels, as has been suggested by some, appears not improbable; but this, I apprehend, does not explain the matter, or bring us any nearer the truth than we were before.

Hemorrhages are usually divided into two classes, the active and the passive. The former occurring in strong robust persons, the latter in such as are naturally feeble, or who have become so by disease, impoverished diet, or excessive evacuations. This distinction, however, is not of much value, in a practical point of view, as it is often extremely difficult to refer the cases that are met with to the one or the other of these forms; nor is it of any importance in reference to the proximate causes of the disease, inasmuch as they are usually the same in both varieties. By others, again, hemorrhages have been divided into acute and chronic, — an arrangement which is, perhaps, on the whole, the least objectionable of the two.

Hemorrhages are not always announced by precursory symptoms. In some cases the individual experiences obscure pains in different parts of the body, with a sensation of weight and fulness in the organ from which the effusion is about to occur, and chilliness of the extremities, particularly the feet. The blood, which often escapes with great rapidity, oozing out at innumerable points, is generally of a florid hue, and, although it readily coagulates, it seldom separates into serum and crassamentum, as happens when it is drawn from a vessel at the arm.

Sanguineous effusions sometimes occur as a *critical* discharge, especially in cases of protracted fever. Nature, in such cases, is said to make an effort to get rid of the original disease, by establishing an efflux in some remote part, which, in most instances, is the nose. Nevertheless, as the occurrence is not constant, it can be regarded in the light merely of an accidental circumstance, produced by some disruption in the balance of the circulation.

The *quantity* of blood varies in different cases, from a few drops to several quarts. Generally speaking, it will be likely to be much greater when it proceeds from the rupture of a

vessel,—than when it is the result of exhalation. In no part of the body is hemorrhage so apt to be profuse as in the mucous system. In the uterus, the bronchial tubes, the stomach, and intestines, an immense quantity of blood is frequently discharged in the course of a few minutes.

When blood is effused, one of four circumstances happens in regard to its final disposal. In the *first* place, it may be entirely rejected. This is generally witnessed when the hemorrhage occurs in the œsophagus, the stomach, or bowels. In all these situations, as well as in the urinary, genital, and respiratory passages, the blood is voided either in a pure state, or blended with such substances as may happen to be lodged there at the time. *Secondly*, the fluid may be absorbed. This frequently takes place in the subcutaneous cellular tissue, and sometimes, also, in the brain, lungs, and other viscera. *Thirdly*, the blood may remain, and become organized; or, *fourthly*, it may act as a foreign substance, and induce fatal inflammation.

The above account would be imperfect were we to pass by the changes which are wrought in the effused blood. When it is poured into the pulmonary organs, it is usually quite fluid, and of a bright florid hue, from the influence of the atmosphere. In the stomach, on the contrary, it is usually more or less coagulated, and of a black color, from the action of the acid and gaseous contents of the organ. In most of the other viscera, properly so termed, it is of a dark complexion, and for the first day or two of a fluid consistence. Subsequently, by the action of the neighboring absorbents, the coloring and serous portions of the blood are in great measure removed, and the consequence is that it not only becomes lighter but likewise more dense and firm. At a still more remote period, the clot becomes organized, and not unfrequently also encysted. To these important changes, with which every physician should be thoroughly acquainted, we shall revert when treating of cerebral apoplexy, a disease in which they are generally most conspicuous.

CHAPTER VI.

Of Softening.

One of the most unequivocal signs of Inflammation.—Structures most liable to be affected by it.—In what anatomical Element is the Lesion seated?—Causes.—Opinions of Rostan and other writers.—Degrees of Softening.

ONE of the most singular effects of inflammation is softening of the affected parts. This lesion was first pointed out by the late distinguished Professor Dupuytren, of Paris. The term which is here used to designate it is synonymous with that of mollescence or *ramollissement*, so much in vogue among the French pathologists. Next to redness, softening may be regarded as decidedly the most unequivocal sign of the existence of phlegmasial irritation, and it will therefore be necessary to speak of it somewhat in detail.

Softening does not occur with equal frequency in all the organs and tissues of the body, yet there is perhaps not a single one that is not sometimes affected with it. The parts in which it is most common, as well as most strongly marked, are the brain, the spinal cord, and the mucous membrane of the alimentary tube, together with the spleen and liver. It is occasionally seen in the tendons and cartilages, where it forms the principal, if indeed not the only, character of inflammation, both the redness and turgescence being, in most cases, entirely wanting here. The blood-vessels, the serous and fibrous textures, the ligaments, the voluntary and involuntary muscles, and the external teguments are among those parts of the body which are least liable to be affected with this disease, owing, no doubt, to the peculiarity of their nervous and vascular endowments. In the bones, softening is by no means uncommon, and, what is remarkable, it seems sometimes to pervade nearly the entire skeleton. When this is the case, the other organs and textures of the body usually participate in the lesion, although so slightly, perhaps, as to be scarcely observable in making the dissection.

The interesting question here arises,—what is the particu-

lar anatomical element in which the lesion now under consideration resides? As might be expected, observations have been made with a view of deciding this point, and the result would seem to be, that, in nearly all cases, the structure most at fault is the interstitial cellular. In the liver, for example, the diminution of cohesion is never so strongly marked in the granulations as in the cellular substance by which they are surrounded. So likewise in the muscles, the fleshy fibres frequently retain their healthy consistence long after the connecting tissue is converted into a soft shreddy mass. In the stomach and bowels, also, the mucous membrane is never softened by inflammation without the cellular structure beneath participating in it. Indeed, it may well be doubted, I think, when the lesion takes place in this situation, whether it be not always seated in the first instance in the submucous substance. This, however, is a point concerning which we have no positive data.

The most common cause of softening, as has been already stated, is inflammatory irritation, generally of an acute, but sometimes of a slow, chronic character. It should also be remembered that it is sometimes the result of causes which exert their influence after death. In making examinations, nothing is more common than to find the posterior parts of the lungs much softer than the anterior, simply, it would appear, from the stagnation of the blood; and, in the stomach, mollescence, it is well known, is frequently produced by the action of the gastric juice. These facts should be kept in mind by the pathologist; otherwise he will be in danger of confounding these phenomena with such as are caused by inflammation. There is a species of softening, particularly frequent in the brain and spinal cord, which is supposed by Rostan and others, to proceed from an obliteration of the arteries. That mollescence may be brought about in this way, I do not feel disposed to deny; at the same time it must be confessed that it is far from being certain, that, when the nutrition of an organ is thus interrupted, the changes which it experiences are not of a character which assimilate it to inflammation. This opinion will not appear less plausible when it is recollected that there is always more or less effusion of serosity, of lymph, or even of purulent matter. There can, indeed, strictly speaking, be no such thing as dry softening; and whenever, therefore, the fluids here referred to are found,

there is reason to believe that they are poured out as an effect of inflammatory irritation.

The degree and consistence of a softened organ cannot be very well defined in a general way, and the consideration of it must therefore be postponed until we come to speak of the mollescence of individual structures. In its color it may vary from a milky white, as in the brain, to deep red, as in the lung, with every intermediate shade of ash, brown, and yellowish. What is singular, the blood-vessels in many cases seem as if they had entirely disappeared, whilst in others they are so weak as to be incapable of withstanding the slightest pressure, or receive the finest injecting matter.

CHAPTER VII.

Of Gangrene.

Definition. — Parts most apt to suffer. — Color and Consistence. — Extent. — Manner in which Nature guards against the occurrence of Hemorrhage. — Causes, of two kinds. — Malignant Pustule. — Gangrene from the use of Ergot. — From the exhibition of Tartar Emetic. — Senile Gangrene.

THE last termination of inflammation, of which we shall speak, is gangrene. In the United States and Great Britain, the term gangrene is used to denote that condition of a part which immediately precedes its death. In France, however, a more considerable latitude has been given to its signification, the physicians of that country regarding it as synonymous with mortification and sphacelus. It is in this latter acceptation that the word will be employed in the present work.

Gangrene, mortification, or sphacelus, then, may be defined to be the extinction of the vitality of a part of the body, the rest of the organism retaining its life. When this event is about to take place, the affected structure loses its sensibility, it becomes cold, the blood ceases to circulate, and absorption is suspended.

The process by which these changes are accomplished is generally progressive, its rapidity varying with the constitution of the patient, the violence of the exciting causes, and, above all, the nature of the suffering structure. Thus, gangrene, in some cases, takes place in the course of a few hours, whilst, in others, it does not make its appearance for several weeks or even months from the commencement of the inflammation. Much diversity prevails amongst the different organs and tissues in regard to their liability to become affected with this lesion. The cellular, cutaneous, and mucous, may be enumerated as the textures which are more frequently seized with mortification than any other ; and it is worthy of remark that these are parts which are extremely well supplied with blood, especially the two latter. Nevertheless, in the skin and cellular substance, this event takes place most

frequently in situations which are remote from the central organ of the circulation, as on the hands, feet and posterior portions of the trunk. In the mucous system, the parts most liable to mortification are the gums, the inside of the cheeks, the tonsils, the colon, the inferior third of the ileum, the urinary bladder, and the lining membrane of the vulva. The serous membranes, muscles, ligaments, tendons, aponeuroses, and cartilages are rarely affected in this way; and the same remark holds good in reference to the arteries, veins, and absorbents. The three latter of these structures, indeed, seem to possess a most astonishing conservative power, and hence it is not uncommon to find them retain their integrity in the midst of the sphacelated part. In malignant scarlet fever, attended with mortification of the tonsils and upper part of the neck, I have several times seen the common carotid go on in the performance of its function, and the individual recover, notwithstanding the detachment of immense sloughs of the skin and cellular substance; and similar phenomena have often been witnessed in gangrene of the inferior extremities.

It seems doubtful from the cases on record whether sphacelus has ever been actually observed in the uterus, kidneys, ovaries, supra-renal capsules, the thyroid body, the testicles, pancreas, and salivary glands. The occurrence, at any rate, is extremely rare, and further observations are wanting to settle the question. Gangrene of the lungs is by no means so uncommon as was formerly supposed by pathologists: in the liver and the spleen it is also sometimes observed, as also in the brain and spinal cord. The nerves are rarely affected; the heart, perhaps, never, although, as will be shown hereafter, several cases are on record in which the reverse seems to have been true. The bones are often destroyed by gangrene, especially those of the inferior extremities, from causes which often seem to be originally seated in their own structure, or in the fibrous membrane which surrounds them.

The color of the mortified part varies with the nature of the affected tissue. In the lungs it is frequently greenish, black in the spleen, cineritious in the cellular tissue, livid in the skin, brownish or pale yellow in the mucous membranes, and like the leas of red wine in the brain and spinal cord. This statement, of course, is liable to numerous exceptions, to which reference will be made, particularly in their appropri-

ate places. Ligaments, tendons, and fibrous membranes rarely undergo much change of color, unless there is at the same time an abundant effusion of sero-sanguinolent fluid, in which case they occasionally have a reddish, macerated appearance.

It need scarcely be remarked here that the consistence of a mortified part must depend, in great measure, upon the mode of aggregation of its anatomical elements, and upon the amount of blood by which they are nourished. In gangrene of the lung, which contains a large quantity of cellular substance, pervaded by myriads of the finest capillaries, the affected part is generally very soft — sometimes, in fact, a mere diffused putrilage, in which it is impossible to discern the slightest trace of the primitive structure of the organ. Nearly similar phenomena are occasionally observed in gangrene of the brain, spleen, and liver. In mortification of the cellular tissue, especially in the carbuncular variety of it, the loss of cohesion is likewise very considerable; so that this substance can be torn and cut with much more facility than in the normal state. The harder solids, as they are denominated, on the contrary, undergo very little change of consistence, as is exemplified in tendon, ligament, and bone.

Much of this loss of cohesion is owing to chemical decomposition. The period at which this begins is greatly influenced by the structure of the affected part, the quantity of effused fluid, the season of the year, and the nature of the dressings. There are several species of gangrene, where, as will be seen presently, the affected part is perfectly dry, hard and shriveled, approaching to the condition of a rotten pear. In other cases the mortified mass is remarkably soft and baggy, exuding, on being divided, a large quantity of thin, turbid, sanguous matter. It is on the absence of this fluid, on the one hand, and on its presence, on the other, that is founded the distinction made by some writers, of dry and humid gangrene. The exhalation which arises during the progress of the decomposition, and which gives to gangrene its characteristic fetor, has not been thoroughly investigated, I believe, by any chemist: probably it is of the nature of hydrogen gas, holding a certain quantity of carbon, sulphur, and phosphorus in solution.

The gangrene may effect a single tissue, or appear simultaneously in a considerable number. This latter occurrence is well exemplified in severe inflammation of the lower extremity: commencing in the subcutaneous cellular tissue, it

gradually extends to the skin, the aponeurosis, muscles, periosteum, and bones, which, together with the vessels and nerves, it sometimes converts into one common sphacelated mass, of a dark livid color. In a case of this description, should the patient's constitution be good, the gangrene, after having proceeded a certain distance up the limb, manifests a disposition to stop, or, more properly speaking, the surrounding structures make an effort to resist its further encroachment. This attempt is generally indicated by the appearance of a red line, for which the surgeon, as is well known, always anxiously looks, as it forms a circumvallation around the dead parts, and shows that the morbid action is arrested. The next step which nature takes in this enterprise is to set up an ulcerative absorption, by which the mortified mass, now called a slough, is gradually detached, the structures that give way first being the cutaneous and cellular, then the muscular and fibrous, then the nervous and vascular, and, finally, the ligamentous and osseous. The absorption by which this important change is effected is confined exclusively to the living parts, and the rapidity with which it takes place is influenced by a great variety of causes, which it would be needless to enumerate.

One of the most interesting phenomena, in connection with this sloughing process, is the manner in which nature guards against the occurrence of hemorrhage. Long before death has accomplished its work, the blood in the vessel of the affected limb begins to coagulate, and, by the time the parts are ready to be detached, the inspissated fluid is firmly glued to the inner surface of the tubes by adhesive inflammation. The arteries and veins, however large, are thus, as it were, hermetically sealed, so that, on amputating the limb, particularly when the plug extends high up into the sound parts, there is frequently not the slightest hemorrhage.

We now proceed to speak of the causes of gangrene. These may be divided into two great classes,—into those, namely, which act directly upon the part, and into those which exert their deleterious influence through the constitution. Of the former, it is not necessary to say any thing in a work of this kind, further than that they are either of a mechanical, chemical, or physical character: of the latter, however, as they involve some highly interesting circumstances in relation to the operation of internal poisons, it will be proper to give a more comprehensive account.

Among the internal causes of gangrene, are organic diseases of the heart, leading to deficient circulation in remote parts of the body, imperfect supply of the nervous influence, habitual intemperance in eating and drinking, want of nutritious diet, and the inordinate use of spured rye.

That an impoverished state of the blood, with lesion of the innervation, is a frequent cause of gangrene, is a fact which is now pretty generally admitted by medical men. In the lower orders of society, mortification from this source sometimes manifests itself in the mucous membrane of the mouth and vulva, in the groin, axilla, and feet. The influence which a diseased state of the blood exercises in the production of this lesion is well exemplified in scurvy. Persons who labor under this affection are extremely prone to inflammation from the slightest accident, followed frequently by gangrene. The state of general debility, too, as has been justly remarked by Carswell, which prevails during protracted fevers, is well known not only to favor the development of inflammation, but to give this disease a peculiar tendency to end in mortification.

The malignant pustule, as it is termed, a disease which is not uncommon in certain provinces of France and Germany, and which will be noticed more particularly hereafter, seems to be often produced by causes which exert their influence through the medium of the circulating fluids. In the experiments of Hamont and Leuret, blood taken from the veins of an affected animal and transfused into those of a sound one, readily induced this singular malady. Even the flesh appears to be strongly impregnated with the septic agent, numerous examples being on record where death was occasioned by using it as food.

There is a singular species of gangrene which is very rare in this country, but sufficiently common in certain districts of France, Switzerland, and Germany, where it sometimes prevails endemically. Many of the inhabitants of these countries, it is well known, use rye almost exclusively as an article of food. In very moist seasons, this grain often contains a large quantity of blighted matter, which has received the name of *ergot*, *secale cornutum*, or *cock-spur*, and which, when employed for a considerable length of time, is supposed to give rise to the disease in question. The attention of the profession was first called to this affection by M. Dodard, a French physician, in 1676: it was examined

with considerable accuracy by M. Noel, surgeon to the Hôtel Dieu, of Orleans, and, since his time, has been frequently made the subject of investigation ; but, for the latest and most correct account of it, we are indebted to M. Lessier.

This species of gangrene is, in every respect, a most singular affection. In the cases described by M. Noel, it always began in the toes, from whence it gradually extended along the foot and leg, until, in some instances, it reached the upper part of the thigh, or even the trunk. In the majority of the patients, the gangrene was preceded by redness, pain, and burning heat, which subsided in the course of four or five days, leaving the parts cold, hard, dry, insensible, and black like charcoal. After some time, sloughing commenced, and, if the system was not too much exhausted, nature alone was frequently sufficient to effect the separation of the affected limb. In one of the cases, both thighs were detached at the ilio-femoral articulation.

In a second series of cases, delineated by Gassoud, the disease is described as occurring in the feet and legs, together with the hands and arms. The symptoms which accompanied it varied in different individuals. In some, there was considerable swelling, with great pain and heat ; in others, the tumefaction was combined with redness, and the patient labored under fever and delirium ; in others, again, the suffering was entirely local, and was sometimes intermittent, sometimes constant. The separation of the black mortified mass commonly took place spontaneously, and was often attended with the most excruciating pain. Neither in these, nor in the cases mentioned by Noel, was there any of the *fœtor* which is so generally present in ordinary gangrene. M. Bossau, however, met with some instances of this affection in which the parts exhaled an insupportable stench ; but it is worthy of remark, that, in most of them, the gangrene was not of the dry kind. The disease, it would seem, attacked, indiscriminately, men, women, and children.

For a long time doubts were entertained whether ergot was really the cause of this disease. With a view of settling this point, M. Lessier, an eminent French physician, was requested by the Royal Academy of Medicine of Paris, to investigate the matter experimentally. The subjects of his researches were ducks, turkeys, and pigs. Without going into details, which would be foreign to my design, it may be briefly stated, that these animals were strictly subjected to

the use of spurred rye ; that most of them died between the tenth and twenty-fourth day, and that distinct marks of sphaecelus were perceived in different parts of the body, both externally and internally.

How, it may now be asked, does ergot operate so as to produce this singular effect ? On this point we are still in complete ignorance. The only idea I can form of the influence of this substance is, that it exerts its deleterious influence, in the first instance, on the blood, and, through it, upon the capillaries, causing inflammation in them, followed by gangrene. This opinion, indeed, seems to be fully borne out by the phenomena which precede this event, not only in the human subject, but likewise in the inferior animals. That the blood and its vessels are alone implicated, we do not assert : the nervous system, no doubt, is seriously involved : all that is contended for is, that these are the parts which receive the *primary impression* ; and, in this view, as before hinted, we are amply sustained by the facts of the case.

This affection, as was before intimated, is very rare in the inhabitants of this country. It has been several times noticed by our eastern practitioners ; but I am not acquainted with a single instance that has occurred in the Valley of the Mississippi ; though such, no doubt, has been the case. In Chester county, Pennsylvania, it prevailed extensively among the horned cattle in 1819, and, in the following year, in Orange county, in the State of New York. In these instances the disease seems to have proceeded from the use of the *green grass*, the *poa viridis*, the seeds of which, as was ascertained by Dr. Mease, of Philadelphia, were affected with the ergot.*

A very curious circumstance, in relation to the present subject, has been recently brought to light by some of the French pathologists. I allude to the fact that emetic substances, when taken in excess, will give rise, not unfrequently, to inflammation of the extremities, rapidly followed by gangrene. Several cases, illustrative of this effect, are recorded by Dr. Barbier, of Paris, in his excellent work on the *materia medica*.† One of them came within his own knowledge, in a woman, who, after having taken a dose of drastic cathartic medicine, was seized with violent vomiting and purging,

* Domestic Encyclopedia, vol. ii. p. 52, and vol. iii. p. 196.

† T. iii. p. 327, quatrième edition, Paris, 1837.

which, in a short time, produced the most alarming prostration of the vital energies. In this condition she was conveyed to the Hôtel Dieu. Next day the point of the nose, the ears, and cheeks, assumed a deep purple color, and similar spots appeared on the feet and hands. All these parts were now rapidly attacked with gangrene, and one of the feet sloughed entirely off. In the other case, the particulars of which are detailed in the "Journal de Medicine," of Paris,* the patient, also a female, was attacked with severe cramp, spasm of the extremities, and extreme anguish. These symptoms were followed, in a short period, by lancinating pains in the limbs, with dark blotches in different regions of the body. Gangrene appeared in the lower lip, the chin, the cartilaginous part of the nose, and in several of the toes,—all of which successively dropped off. Are these effects produced in the same manner as when the system is laboring under the influence of ergot? To me, I must confess, the *modus operandi* of these substances is quite incomprehensible; yet the circumstance is certainly a curious one, and will no doubt receive further attention. The lesion may be said to be owing to the great and rapid reduction of the powers of life, giving rise to inflammation of the capillaries; but, if this be true, how happens it that all cases of general debility are not followed by gangrene? The parts are placed in the same relation as one that is deprived of its nervous supply.

Closely allied to the disease now described, is that affection which was so well portrayed by the celebrated Pott, of England, under the name of mortification of the toes and feet. As has been justly remarked by this great surgeon, the lesion is most common in aged persons, though the young are by no means exempt from it. Its progress is generally slow and insidious, commencing sometimes without the slightest pain, uneasiness, or swelling. In the majority of instances, it makes its first appearance at the inside of one of the smaller toes, by a circumscribed bluish spot, which is more or less painful, and is soon followed by a separation of the cuticle, leaving the skin beneath of a dark red color. In some instances the gangrene begins at a number of points at once, and when this is the case, it is usually more rapid in its march, as well as accompanied with more urgent symptoms. In its progress, it gradually involves the whole foot, and not un-

* T. xxxviii.

frequently the leg, and even the thigh, the soft parts of which are converted into a black, bluish, or brownish mass, often extremely offensive to the smell. The sloughing process generally goes on rapidly, and the bones occasionally drop off at the joints.

Mr. Pott, who observed this disease chiefly in gouty persons, states that it is much more common in men than in women, in the proportion nearly of twenty to one. In France, however, it seems to occur with equal frequency in both sexes, for the reason, probably, that their mode of living is more alike than in England.* In this country, the disease is of very rare occurrence, some of our most experienced surgeons having never witnessed a case of it. The cause of this variety of mortification has been variously explained by different writers. Mr. Cowper, an old English author, threw out the idea that it might depend upon ossification of the arteries of the inferior extremities,—a view which has since been embraced by Mr. Hodgson and other writers. Numerous examples, in fact, might be cited in corroboration of this opinion; yet, that it is not exclusively true, is apparent, when it is remembered that the disease occasionally occurs in subjects in whom the arteries are perfectly free from the degeneration in question. In these cases, it is not improbable, I think, that the capillaries, both arterial and venous, are the original seat of the affection, inflammation being set up in them by some stimulating property of the blood, or by other causes, the precise nature of which is unknown to us.

* Begin, Dict. de Medicine et de Chirurgie Pratiques, art. *Gangrene*.

CHAPTER VIII.

Of Ulceration.

Definition ; intricate nature.—Most common in the Skin, Cellular Tissue, and Mucous Membranes.—May be slow or rapid.—Manifests a tendency to extend towards the nearest surface.—Produced by Inflammation.—Ulcers sometimes heal: the process by which this is accomplished.—Ulceration a sanative effort.

By this term I understand the solution of eontinuity of a texture from the absorption of its moleeules. It is synonymous with what was anciently ealled erosion, and with what some modern pathologists, with Mr. Hunter, denominate ulcerative absorption. Of the intimate nature of this lesion nothing is known with any eertainty, beyond the fact that it is usually conneeted with inflammation.

Although there are few parts whieh are not suscepible of ulceration, yet that this oceurrence is much more frequent in some textures than in others, is a faet of whieh every one is convineed by daily observation. The eutaneous, mucous, and cellular tissues are infinitely more often affeeted than all the rest put together. This is exemplified in the numerous blotches which sometimes cover almost the whole body, and in the erosions which are so frequently noticed in the bowels, the mouth, the throat, the vagina, the gall-bladder, and the larynx. The heterologous formations, the bones and teeth, with the artieular eartilages and their coverings, come next in order. The serous membranes, properly so called, the fibrous and museular struetures, rarely suffer from ulceration ; and the same is true of the internal viscera, excepting the uterus. Nature seems also to have endowed the vaseular system with a remarkable power of resisting this process. Vessels, even of large size, are occasionally completely exposed, from the destruction of the surrounding parts, and yet entirely escape the disease.

It is a remarkable faet, that parts even of the same structure will take on ulceration much more readily in some situa-

ations than in others. This is well exemplified in the digestive mucous membrane. Thus, for one erosion in the stomach, we find at least a thousand in the ileum and the colon ; and so also with the skin, though not in the same ratio, of the upper as compared with that of the lower extremity. Newly-formed parts are extremely prone to ulceration. A cicatrix is rapidly destroyed by this process, because it is much more feebly organized than structures that have existed longer. The same thing happens in the callus of a fractured bone.

The ulceration occasionally proceeds with great rapidity, destroying as much of the body in a few days as nature can repair in as many months. It is sometimes limited to one texture ; at other times invades a considerable number of them. In the bones, although it usually progresses very slowly, it is often remarkably destructive, whole pieces of the skeleton being, in some instances, literally eaten away. In the skin and mucous membranes, it occasionally persists for years, without greatly impairing the health of the individual. In the articular cartilages, although it may be equally protracted, it generally induces ankylosis, or death from constitutional irritation.

Ulceration always manifests a tendency to extend towards the nearest surface. This is a law which is attended with the most salutary effects ; for, if there were no such provision, the individual, the subject of this process, would often fall a victim to its ravages. This tendency is well exemplified in the tibia. Ulceration commencing in the interior of this bone, generally works its way through the part which is covered merely by the skin and periosteum, nature thus greatly economizing her time, and saving the surrounding structures from much mischief. Another beautiful illustration of this law is afforded by the liver. When an abscess is seated in this organ, inflammation is gradually set up in its peritoneal covering, followed by an effusion of lymph, by which the viscous is glued to the stomach, the colon, or duodenum. Ulcerative action now begins, and, in process of time, a communication is established between the adherent parts, affording a ready outlet for the purulent fluid. In this manner nature effects, in a few days, what, if the opening were made through the skin and muscles, it would require weeks to accomplish.

The great cause of ulceration is inflammation conjoined
VOL. I. 13

with pressure. In many instances, however, it follows suppuration and gangrene. Nor is pressure always essential to the process. In many situations, indeed, as in the cutaneous and mucous textures, ulceration occurs without the slightest aid from this source. On the other hand, there are examples in which pressure appears to be the principal agent, as in caries of the bones produced by the presence of a large aneurismal tumor. The same disease disproves the idea, formerly so current amongst pathologists, that ulceration can never happen without the formation of pus. Were any further illustration necessary of the fallacy of this opinion, we might refer to the mucous textures, where this process often occurs, unaccompanied by the slightest deposition of matter.

The question here comes up, — what is the nature of this concomitant inflammation? Is it of that description to which Mr. Hunter has applied the term *adhesive*? or does it possess a character altogether peculiar to itself? The latter supposition seems to me to be the most plausible, — certainly most in accordance with what we know of the subject. Every practitioner is acquainted with the fact, that an inflammation, apparently of the same kind and degree, produced by the same cause, and affecting the same tissue, will, at one time, end in ulceration, at another, pass off without any such occurrence. This can only be explained on the assumption that the inflammation which precedes and accompanies the ulcerative process is of a specific character, or, in other words, that it is modified by circumstances, either local or constitutional, or both conjoined, which the pathologist cannot appreciate. This opinion is the more plausible, as there are some erosions which invariably result from particular causes, and none other. The venereal ulcer has its peculiar features, not less than the tubercular, the herpetic, or the scirrhouus. All these are specific affections, induced by specific agents, accompanied by specific inflammation, and followed by specific results.

The ulcerative process is usually accompanied with more or less pain. In the majority of cases, it is of a dull aching or gnawing character, as if insects were feeding on the part. Occasionally, it is entirely latent, or the patient experiences merely a slight degree of uneasiness. In some instances, it is continued; in others, intermittent; in others, periodical. With this symptom, there is often irritation, or hectic fever, with rapid emaciation, and great failure of the powers of the system.

The inflammation, which precedes the ulceration, always continues until this process is completely arrested. Andral supposes that it may entirely disappear, and still the erosion go on. This, however, seems to me to be altogether a gratuitous assumption. We must unquestionably, I think, regard this disease as essentially inflammatory in its nature; and, although the part may be perfectly blanched, yet this does not prove that this process is not, to a certain extent, present.

Ulcers sometimes heal. This takes place much more readily in some tissues than in others; but the process by which it is accomplished is the same in all; namely, by granulation. The different steps of this process, together with various other circumstances connected with ulceration, will be described in detail under the head of the different organs and tissues.

Ulceration may be regarded, in some degree, as a sanitary process, or as a means employed by nature to rid the animal economy of extraneous materials. We have already seen that collections of purulent fluids have a disposition to escape by the nearest and easiest route; and this is uniformly effected by the agency of ulceration. A ball lodged under the skin is removed in the same way; or it travels from one region to another, and is finally cut out at a great distance from the place where it was originally situated. It is useful also in the expulsion of tubercular matter, in the exfoliation of the bones, and in the sloughing of the soft parts. In other cases, again, as in old drunkards, the process seems to be designed to relieve the system of hurtful fluids; which it does by establishing extensive sores on the legs, attended with a perpetual flow of irritating matter. Thus we see that ulceration, although apparently a very unpleasant, is in many instances a most fortunate event, and one for which the practitioner often anxiously looks.

CHAPTER IX.

Of Granulation.

Importance of the Subject.—Nature of Granulations.—Difference in regard to their Vascularity and Sensibility.—How modified by Texture.—Are secreting and absorbing Organs.

LEAVING the subject of ulceration, I now come, by an easy transition, to speak of that of granulation. This process, like that of union by the first intention, is one of the grand operations employed by nature for the cure of wounds, and the filling up of ulcers. To the surgeon, a knowledge of this process is of indispensable importance; whilst to the inquisitive physiologist it discloses a series of changes, which, in point of interest, are not surpassed by any in the animal frame, whether in a sound or diseased state.

A granulation is a small, vascular body, generally somewhat mammillated in shape, more or less red, sensitive, and capable of secreting pus. It consists, in the first instance, essentially of coagulating lymph; and the process by which it is formed is very similar to that which is concerned in union by the first intention. Let me be understood. An individual receives a wound involving the skin and cellular tissue. The edges, instead of being brought into contact, are allowed to remain apart. Immediate adhesion being thus prevented, another process, more complex and tardy, is instituted. The sore now becomes painful, and, in short, exhibits all the ordinary phenomena of inflammation. A thin, watery fluid oozes from its surface; and, after some hours,—generally from six to twenty-four,—it is found to be slightly incrusted with lymph, by which its interstices are filled up, and the whole is made to assume a smooth, uniform appearance. The layer thus formed is of a whitish color, somewhat ropy in its consistence, homogeneous, and easily wiped away. If it be allowed to remain, in the course of a short time, varying from one to two days, sooner or later, according to the activity of the sore, the exudation becomes organized by the subjacent old vessels extending into it, or, if we adopt the opinion of some, by the formation of new ones, which inosculate with

those of the divided parts. The surface of the sore is now of a red color, readily bleeds if it be touched, and is elevated into a great number of little rounded bodies, closely aggregated together, which are the rudimentary granulations. Another layer of plastic lymph is next effused, the vessels are still further elongated, and thus incrustation after incrustation is formed and organized, until the cavity is finally filled up.

Not only does each granulation receive one or more arterial and venous branches, but, in all probability, also a small nerve and an absorbent. Such, at least, must be our conclusion, when we reflect upon the fact, that this little body not only bleeds when roughly handled, but that it often becomes highly sensitive, and that it readily absorbs such substances as are placed in contact with it.

The vascularity of these little bodies is much greater, I am disposed to think, than is usually imagined. That they are liberally supplied with vessels is at once indicated by their florid complexion, by the astonishing rapidity of their growth, by the facility with which they bleed when touched, and by the fact that they become hard and tumid if filled with injecting matter. The arteries, the precise number of which is not known, having entered the base of each elevation, soon separate into arborescent branches, which freely anastomose with each other, as well as with those in the granulations immediately around. Accompanying these arteries are corresponding veins, which carry away the blood which is not required for the nourishment of the part, the effusion of lymph, and the secretion of pus, with which the abraded surface is usually covered. Whether the nerves and absorbents are of new formation, or merely elongations of those that previously existed, it is impossible to determine. The latter supposition is probably the true one.

Granulations are often very sensitive. This, however, is not the case every where, or under all circumstances. In the cutaneous and cellular tissues, the granulations are, all other things being equal, infinitely more sensitive than in the tendons, aponeuroses, and ligaments. The same thing is true with respect to the granulations of the bones, except when they spring from the cancellated structure; then they are frequently so tender that it is impossible to touch them without inducing severe pain. These little bodies are also more sensitive when there is much inflammation, and in persons of an irritable and worn-out constitution than in such as

are healthy and robust. In some instances, especially in old ulcers of the leg, they are more than triple the ordinary size, extremely pale, cold, apparently infiltrated with serosity, and so completely insensible that they may be cut without the least pain.

Granulations are absorbing as well as secreting bodies. These properties, however, are not equally well marked in all the tissues. A great difference, for instance, exists in this respect between the granulations which arise from the skin and those which arise from the bones, the former absorbing and secreting with great rapidity, while the latter perform these offices very slowly and imperfectly. A knowledge of this fact is of no little value in the practice of surgery, as it enables us, on the one hand, to avoid stimulating dressings, and, on the other, the application of such substances as have a tendency, when absorbed into the system, to give rise to dangerous results. Not a few cases are on record where arsenic, corrosive sublimate, and other articles of the *materia medica*, placed in contact with a granulating sore, have destroyed life. The extract of belladonna, used in this way, will produce temporary amaurosis, mercury will salivate, and opium, it is well known, will occasion sleep nearly as soon as when introduced into the stomach.

Thus, granulations are a very interesting and important set of textures, extremely complex in their structure, and performing the triple office of pouring out lymph, secreting pus, and absorbing such substances, to a greater or less extent, as are brought in contact with them. The facility with which they are developed is much greater in some tissues than in others, depending on the degree of laxity and vascularity of the part from which they spring. The concomitant inflammation appears also to be of a mixed character, as it is attended with the simultaneous effusion of lymph, and purulent matter; and it is important that the phlogistic action should not transcend certain bounds, otherwise the process will be interrupted, retarded, or wholly suspended. The skin and cellular substance appear, of all other tissues, to be most susceptible of granulation. Mucous membranes, aponeuroses, ligaments, tendons, cartilages, and bones, together with the internal viscera, excepting, perhaps, the brain, rarely heal in this way, and then only after a long time.

CHAPTER X.

Of Cicatrization.

Nature of the Process.—Different Steps.—Do Ulcers never heal from the Centre?—Process of Cicatrization influenced by the Form and Situation of the Sore.—Meaning of the term Cicatrice.—Reproduction of the original Tissues.

THE subject next in order is cicatrization. The remarks which I shall offer here must necessarily be brief, as a great deal of what might be said will more appropriately come in under the head of the different organs and tissues.

Cicatrization is the process which nature employs to heal wounds and ulcers. It is the finishing stroke, if the expression be allowable, of granulation,—the labor which is necessary to polish the surface of the sore, to contract its diameter, and to bring it as nearly as possible to a level with the surrounding structures. This process, although it is not limited to the skin, as might be inferred from reading some modern treatises on surgery, is yet most advantageously studied there, as it enables us to follow nature as it were in the different steps which she employs with a view of accomplishing her enterprise.

The first step in the healing of an ulcer seems to be the subsidence of the inflammation, which becomes gradually less and less, until the surrounding parts regain their natural color, form, and consistence. The sore at the same time sensibly diminishes in diameter, by the contraction and coalescence of its granulations; and its surface, instead of being rough and uneven, assumes a smooth, glassy appearance, its centre, however, being still considerably depressed; or, if the granulations have been very exuberant, unnaturally elevated. Cicatrization is now observed to begin, the first indication of it being a thin, delicate, bluish pellicle, placed along the margin of the breach, where it soon unites with the old skin by an interchange of vessels, nerves, and absorbents. If the part be inspected at a later period, the substance that was

thus deposited and organized, will be found to have increased in thickness and density, and to be gradually extending itself towards the centre of the ulcer by the addition of new matter. It is in this manner, by this successive peripheral action, that the denuded surface is eventually covered over.

But do ulcers and wounds never heal from the centre? This is a topic concerning which pathologists have expressed different sentiments—some maintaining the affirmative, others the negative side of the question. From an inspection of numerous cases, I am convinced that the process of cicatrization takes place only in one way, namely, in that which I have described. To this remark there is but a single exception. In extensive wounds, especially of the lacerated kind, it often happens that portions of the original skin remain, forming so many little patches in the midst of the abraded surface. In such cases, the cicatrization goes on simultaneously around these parts and along the principal edges of the solution of continuity. There is, however, no new law in operation here, the old skin being the starting point of the new one in both instances.

The process of cicatrization is much influenced by the form and situation of the sore. Circular-shaped breaches of continuity heal much slower, *cæteris paribus*, than such as are longitudinal, for the obvious reason that it takes the new skin a much longer time to reach the centre in the former than in the latter. A sore in the leg cicatrizes with more difficulty than one on the trunk; and a callous ulcer than a soft one.

When the cure is completed, a *cicatrice* is left, or, as it is called in familiar language, a scar. This is, of course, always much smaller than the original sore, and still further diminishes by the contraction of the new skin. When the breach of continuity has been of great extent, as when it has been produced by a burn, this contraction is often a source of great mischief and deformity. At first, the cicatrix is extremely vascular, soft, and of a bluish color: afterwards the vessels decrease in size and number, and the part becomes dense, bloodless, and whiter than the original skin. This is well seen in persons who have had confluent small-pox, or in those who have been covered with venereal blotches.

Are the original textures, in the formation of cicatrices, always regenerated? and, if so, in what respect, if any, do they differ from them? Cartilages and muscles are said to

be the only parts which are not susceptible of being reproduced. But even of this I feel extremely doubtful; certain am I that I have seen muscles, which were almost entirely torn asunder, unite through the medium of fleshy matter. Very recently, I had under my charge a healthy lad, eleven years old, who had a large piece of the great pectoral and broad dorsal muscles torn away by a steam-engine, in which the breach of continuity was repaired by a substance perfectly identical with the original. The granulations were unusually florid, highly sensitive, and grew with astonishing rapidity. In old subjects, it is not improbable that the junction is sometimes effected by tendon. The cartilages of the ribs generally unite by osseous matter, as certain pieces of the skeleton, such as the patella, the olecranon process, and the neck of the femur, do by cartilaginous.

In most instances, however, the reproduction is imperfect. This is the case even with the skin. The cutis is never so strong or so capable of resisting the effects of disease, as in the normal state; its inner surface is not reticulated, nor is it provided with sebaceous follicles. The mucous network is but imperfectly regenerated, and the epidermis drops constantly off in thin, dry, furfuraceous scales. No hairs are to be seen in the scar; for their roots having been destroyed, they cannot of course be reproduced. The same imperfect developement is observed in the cicatrization of the mucous or some other tissues.

CHAPTER XI.

Of Induration.

Definition. — Historical Notice. — Color, Size, and Degree. — Period necessary for its Production. — Causes.

By this term I wish to designate that peculiar pathological condition of an organ which is characterized by an increase of its consistence, whether arising from the deposition of a new product, from a deficiency of the natural secretion, or simply from the transformation of its elementary tissues. This definition does not include, of course, the induration produced by the heterologous formations, such as tubercle, encephaloïd, and scirrhus, with the latter of which the present disease is unfortunately too often confounded.

Until recently, induration, considered as a special disease, does not seem to have attracted much attention. Professor Andral has investigated it with his usual patience and ingenuity; and a few years ago Dr. Carswell, of London, published a very able article on it in the British Cyclopedie of Practical Medicine, a work which, from its rare excellence, should be in the hands of every intelligent physician. In the United States most of our knowledge in relation to the subject has been derived, as usual, from European sources, and, if I mistake not, the lesion in question has not yet found a place even in our best medical and surgical treatises. This, however, is not very surprising, when it is recollectcd that the same is true of hypertrophy, softening, and hydatid, with numerous other highly important and interesting topics, in respect to many of which we are still greatly behind the present state of the science, mortifying as it is to be obliged to make the confession.

Induration is an extremely common lesion, and may occur in any tissue of the body, but is most frequently seen in the spleen, the liver, the lymphatic ganglions, and subcutaneous cellular substance; next to which the lungs, heart, brain, ovaries, breasts, and prostate gland, are the most common seats of it. No age, nor sex, nor condition of life is exempt from it; and, in France and Germany, it is often witnessed as

an intra-uterine affection, or as occurring within a few days after birth. Like many other diseases that are described in the course of this work, induration may exist alone, or in association with other alterations; may affect a part of an organ, its whole substance, or only one of its anatomical elements.

The *color* of the affected part usually partakes, to a greater or less extent, of the natural complexion of the organ. The most ordinary tints are red and gray, with numerous intermediate shades of white, yellow, brown, and black. As a general rule, it may be stated, that the intensity of the color is in proportion to the vascularity of the affected part, and the violence of the exciting cause. Thus, in acute pneumonitis, the induration — hepatization — is almost always characterized by deep redness, often verging on purple, whilst, in the chronic form of the disease, it is commonly of a dirty pale color, grayish, or dappled. When the induration occurs in structures that are naturally light, as in the subserous, submucous, and subcutaneous cellular tissue, there is always more or less concomitant opacity.

The *size* of a part in a state of induration may be natural, augmented, or diminished. An increase of bulk is by far the most frequent, and is sometimes very considerable in induration of the liver, the spleen, and the lymphatic ganglia. A diminution of size is by no means unusual, but cannot be regarded as a necessary consequence of the disease: the same remarks are applicable to the weight of the affected organ, which is much more frequently above than below the normal standard. There are other physical changes attendant on this pathological condition, which need only be alluded to in this place, such as diminished humidity, altered sonorousness, and loss of elasticity. These changes are strikingly exemplified in inflammation of the pulmonary tissue, which becomes dry, hard, inrestitous, sinks in water, and emits a dull sound on percussion of the chest.

The *degree* of induration is liable to considerable variety, depending upon a number of contingent circumstances. Parts that are naturally soft and flaccid, are often, when thus affected, rendered quite dense, firm, and unyielding. Of this the lung affords a remarkable illustration. In the sound state, this viscus is soft, spongy, and elastic, but, when in a state of induration, it is sometimes almost incompressible, and cuts like old cheese, occasioning a peculiar grating sound under the knife. In induration of the heart, again, the walls of

this organ are at times found so hard and unyielding as not to collapse when pressed, and to emit a sound, on being struck, similar to that of a horn.

Considered in a general point of view, induration may be said to present three degrees, which it is of some importance to distinguish. In the first, the part still retains its moisture, and feels only a little unnaturally dense; in the second, it is already firm, dryish, and considerably altered in color; and, in the third, its consistence is so much increased as to resemble the white of a hard-boiled egg, old cheese, or fibro-cartilage, every trace of its original softness, juiciness, and pliancy being gone.

As to the time requisite for the production of these several degrees of induration, no definite rule can be established, as it is influenced by a variety of circumstances, the consideration of which must be deferred until we come to speak of the special pathology of this affection. I shall therefore content myself, in this place, with observing that, in the great majority of instances, the process is remarkably slow,—weeks, months, and even years elapsing before it reaches its full developement. In other cases, on the contrary, it forms with great rapidity, a few days being sufficient for the alteration of a tissue from its normal consistence to that of a firm, dense mass. Thus, then, if we consider the disease in reference to the period necessary for its developement, it may be said at one time to be chronic, at another acute, the former being infinitely the most frequent.

This necessarily brings us to inquire, in the next place, into the causes of this pathological state. These are referable, for the most part, to inflammation, followed by an effusion of coagulating lymph into the interstitial substance of the affected organ. In the lungs there is frequently, in addition to this, more or less blood poured out, which, combining with the natural structures, gives them a red color. It is thus that red hepatization is established. In chronic cases, on the other hand, the induration is commonly effected by the lymph alone; and hence it is that the organ is usually of a much lighter hue. In the hardening of the subcutaneous cellular tissue of infants, a disease of pretty frequent occurrence in certain districts of Europe, the effected matter is generally impregnated with two coloring principles, the one of an orange red, the other of a bluish shade, both of which are stated by M. Chevreul to exist in the blood.

From the foregoing considerations, it is certain that one va-

riety, at least, of induration is dependent upon inflammatory irritation. In a second series of cases, the lesion, if such it can be called, appears to arise from a deficiency merely of the natural secretion. In this category belongs the induration of the various organs and tissues observable in old people. As we advance in life, the whole body experiences an astonishing change in its consistence: many of the vessels are obliterated, the juices are dried up, the solids are rendered hard and rigid, and, as a consequence, the movements are difficult and imperfect. An increase of consistence from this cause is generally most considerable in the cellular tissue, the mammae, the ovaries, the prostate gland, the muscles of voluntary life, and the bones, the latter of which sometimes acquire a degree of hardness equal to that of ivory. Were I asked what is the proximate cause of this condition, I should say that it consisted in a diminution of the vascularity of the affected part, attended with a deficiency of the normal secretion, and perhaps, also, a partial absorption of its more tender anatomical constituents. The part thus becomes hard, dry, and, where the circumstances are favorable, shriveled and corrugated.

In a third series of cases the induration is traceable to a real transformation; that is to say, some of its anatomical elements disappear, leaving nothing but the original frame-work of the affected part. Examples of this description are occasionally seen in the liver, spleen, and lungs, around hydatids, serous cysts, tubercles, and other tumors. The irritation caused by the presence of these adventitious growths produces a partial absorption of the natural structures, leaving those which remain in a dense and indurated state. Similar effects are sometimes brought about by protracted compressions, whether occasioned by bands of false membrane, or by large accumulations of fluid. Of this, a striking illustration is furnished by the lung. In chronic pleuritis, attended with copious effusion, this organ is often reduced to the size of a small cake, by the approximation simply of its solid textures, which are thus rendered unnaturally dense and hard. If the compression is not kept up too long, these textures may be made to resume, in time, their natural bulk, form, and consistence; and so the respiratory function is gradually restored. This variety of induration, it may now be observed, is almost constantly associated with atrophy.

Such are the several forms of induration which have been

noticed in the different organs and tissues of the body, and the causes under the influence of which they are produced. Let us next proceed to inquire, whether parts thus affected can regain their natural consistence, and, if so, under what circumstances ?

The former of these queries can be easily answered ; the latter properly belongs to therapeutics, and need not, therefore, be particularly discussed on the present occasion. That induration is susceptible of being cured, daily observation abundantly testifies. This remark is especially true in relation to the chronic form of the lesion : in the acute it is not so common, the disease usually reaching a fatal height before the system can properly react ; yet even here recovery is far from being infrequent. As the induration of which I am now speaking is caused by the deposition of a new product, it is obvious that whatever has a tendency to remove this, must be instrumental in bringing about the restoration of the affected part. It is with a view of accomplishing this object, that the practitioner resorts to the exhibition of iodine and other kindred articles, when the disease is located in some internal organ ; that he uses friction and other stimulating means, if it happen to be seated externally. In either case he is desirous of producing the same effect, namely, the absorption of the affected substance, the incorporation of which with the natural textures gives rise to the lesion under notice. The time required for effecting this object cannot be specified, as it must be influenced by a great variety of circumstances which it would be out of place to consider here. In acute cases, the induration frequently subsides in the course of a few weeks, even when it involves a very large extent of surface and a multiplicity of tissues : in chronic ones, on the contrary, the process is usually very tardy,—months elapsing before this event is brought about. In the mean time, the function of the part is imperfectly executed, and the longer the case is protracted the greater will be the danger that the organ will never recover its original consistence. Under such circumstances the affected textures frequently undergo the cartilaginous, the fibro-cartilaginous, and osseous transformations ; and, it is even thought by some, that they are apt to degenerate into malignant disease. This, however, is doubtful : at all events, I have never seen a case in confirmation of it.

CHAPTER XII.

Of Hypertrophy.

Meaning of the Term.—Liabilities of different Structures.—Causes.—May be general or local.—Color, Weight, and Volume, of the Part affected.

THE word hypertrophy is derived from the Greek $\upsilon\pi\epsilon\rho\tau\rho\omega\eta$, and literally denotes an excess of nutrition. Introduced into our anatomical nomenclature scarcely thirty years ago, it was originally restricted to those preternatural enlargements which are so frequently found in the heart and thyroid gland. As understood at the present day, however, it has a much more extensive application, being employed to designate an important class of lesions, the essential character of which consists in an abnormal developement of the weight and volume of the various organs of the body, without, in most instances, any accompanying alteration of their organization and structure.

With the exception of the serous membranes, the ligaments, tendons, and fibrous envelopes, there is not a single organ which has not been occasionally found in a state of hypertrophy. Nevertheless, there are some structures in which it occurs more frequently than in others, and amongst these may be particularly specified the heart, the adipous tissues, the spleen, the thyroid gland, the lymphatic ganglions, the breast, the bones, and the blood-vessels. Hypertrophy is seldom seen in the brain, the spinal cord, and nerves. It rarely commences in people below middle age, and from forty to fifty may be mentioned as its favorite time of invasion; but it is often observed in persons much younger than this, as those who are not more than five, ten, or fifteen. Indeed, it would seem occasionally, as is the case of the thymus gland, to come on soon after birth, if not before.

As to the causes which are concerned in the production of hypertrophy, some are of a general, others of a local character. Of the former, very little can be said to be known with

any degree of certainty, as the affection in question sometimes occurs in spite of the most abstemious course of living. In polysarcy, the body has been known to attain the enormous weight of upwards of seven hundred pounds, without the individual being at all remarkable as a large eater. In such cases,— which depend chiefly upon an inordinate developement of fatty matter,— there would seem to be a peculiar diathesis,— every thing, almost, that the person consumes being converted into adipous substance. Not less notable is the hypertrophy which occasionally takes place in the bones, liver, spleen, and lymphatic ganglions, of scrofulous children.

Of general hypertrophy a most extraordinary example is recorded in the first volume of a French periodical, entitled "The Hebdomadary Journal of Medicine." The individual was a girl, twenty-nine years of age; during the last eleven of which she had suppression of the menses, embarrassed respiration, numbness of the limbs, and frequent attacks of headache, with progressive developement of the cutaneous adipous, cellular, and muscular tissues. At the period here specified, the face was enormously enlarged, the tongue almost filled the mouth, the neck was extremely thick, and the breast reached nearly to the chin. The circumference of the trunk was five feet two inches, just equal to the height of the body, and the extremities, both upper and lower, are said to have been prodigiously big. This extraordinary bulk was not caused by the excessive accumulation of the subcutaneous fat alone, as all the external muscles appeared prominent and well-defined. The heart was hypertrophied in the same proportion, and struck with unusual violence against the side of the chest. The brain likewise participated in the abnormal growth, and the girl finally became idiotic. In this case the symptoms above referred to are obviously insufficient to enable us to account for the origin of the excess of nutrition, and we must therefore suppose that the individual labored under some constitutional peculiarity.

Local hypertrophy may occupy an entire organ, or, as more frequently happens, be confined to particular sections of it; and it may exist either alone, or in connection with other lesions.

The local causes which manifest their effects in the production of hypertrophy are, first, chronic inflammation; secondly, mechanical obstruction; thirdly, inordinate exer-

cise. Each of these topics we shall endeavor briefly to illustrate.

That chronic irritation may produce hypertrophy, is a fact of which every pathologist must have witnessed frequent examples. Who has not seen the lymphatic ganglions of the groin preternaturally enlarged from irritation of the head of the penis, of the mesentery from ulceration of the ileum, or of the bronchiæ from disease of the lungs? Enlargement of the liver and spleen, sometimes carried to a very great extent, arises undoubtedly from this cause. In chronic dysentery, not only the mucous and submucous cellular textures become hypertrophied, but the affection often extends to the muscular tunic, which occasionally attains an extraordinary degree of developement. The follicles and villosities, which are imperceptible to the naked eye in the healthy state, are also rendered extremely prominent, the former being sometimes of the size of a mustard-seed, the latter more than a line in length. A similar developement is frequently observed to take place in the coats of the urinary bladder, in consequence of chronic inflammation.

Hypertrophy may be caused, secondly, by some mechanical impediment interfering with the due performance of the functions of an organ. This is frequently seen in the heart, where, in consequence of the existence of disease of the valves, preventing the easy passage of the blood, the viscus is obliged to undergo increased action, and so becomes more or less enlarged. In the muscular fibres of the stomach, the very same change is frequently witnessed from obstruction at the pylorus; and in those of the urinary bladder, from stricture of the urethra, or enlargement of the prostate gland.

Hypertrophy, in the third place, may occur solely from the increased action of an organ in the discharge of its normal functions. Of this variety, examples are found in the muscular system of animal life, in the lungs, and in the kidneys. In every part of the frame, the muscles are proportional, in size and structure, to the efforts required from them; and it is a law of nature, that, whenever they are frequently called into action, their fibres become considerably augmented in thickness, and capable, consequently, of much greater exertion. Thus the blacksmith, who constantly uses his arms in striking with his hammer, has much larger and stronger muscles than the dancing-master, who merely employs his legs.

So also with the lungs and kidneys. When one of these organs is imperfectly developed, compressed by effused fluid or some morbid growth, or, as in the case of the latter, entirely absent, the other is sure to become preternaturally expanded, and thereby compensate for the deficiency. There are some viscera which are subject to temporary hypertrophy. Of this description are the uterus and the breast. During pregnancy and lactation, these organs increase very much in bulk, but again diminish soon after parturition and weaning.

The color of a hypertrophied organ is subject to considerable diversity. Most generally, perhaps, it is somewhat heightened; especially so, when the affection is wholly physiological. Occasionally, it is very much diminished; for what reason, is not precisely known; and cases are often observed, where it is apparently quite natural. The consistence may likewise be normal, diminished, or increased. These three conditions do not, however, occur with equal frequency. An increase of density is by far the most common, and is particularly conspicuous in hypertrophy of the heart, mammary gland, the muscular fibres of the stomach and colon, the lymphatic ganglions, cellular tissue, bones, liver, spleen, and kidneys. A diminution of consistence is extremely rare, and cannot be viewed as a necessary consequence of the lesion in question.

That there should be an increase of weight of the affected organ follows as a matter of course in all cases where the lesion is not conjoined with atrophy. An augmentation of volume is a circumstance which is by no means constant. Thus, in hypertrophy of the heart and bladder, there may be great development of the muscular fibres, with nothing save a diminution of the size of their cavities. A change of form always arises when the hypertrophy is partially circumscribed, or limited to a particular point, as in the bones, the skin, heart, bronchial tubes, and blood-vessels.

Hypertrophy, as has been already intimated, essentially consists in an augmentation of the nutritive function. When in a state of unusual activity, the quantity of blood which an organ receives is considerably increased, and, in consequence, becomes of a deeper color than one that is less used, at the same time that it augments somewhat in density. The reason of this will be evident, when it is recollected that the arteries which are sent to the hypertrophied viscera are ab-

normally large, and therefore qualified to deposit a much greater amount of nutritive matter. The elementary particles are probably not increased in number, but such as already exist are augmented in size, and it is in this manner that the change under consideration is brought about. In that variety of it which results from chronic irritation, it is not unlikely, I think, that there is often superadded to the alteration just mentioned a deposit of new substance in the cavities of the connecting cellular tissue, leading thus to a real change of structure. The effects of hypertrophy, together with its symptoms, will be pointed out when we come to speak of this lesion as occurring in different parts of the body.

CHAPTER XIII.

Of Atrophy.

Definition.—May be general or partial.—Causes: want of Exercise; diminution of the Nervous Influence; deficient supply of Blood.

DIRECTLY the reverse of the lesion now described is atrophy,—an affection which, from the frequency of its occurrence, and from the great attention which it has received of late years from the pathologist, is a subject of too much interest to be passed over without some consideration in this place. Like hypertrophy, with which it often coexists, it may pervade the entire organism, or be limited to a single viscus, or even to one of its elementary constituents; and as the one essentially consists in an increase of the nutritive function, with a corresponding augmentation of bulk, so the other must be regarded as depending on imperfect exercise of the same function, with a corresponding diminution of the affected part.

General atrophy, commonly called marasmus, emaciation, or consumption, frequently arises from organic disease of the lungs, heart, and stomach, and from morbid enlargement of the mesenteric ganglions, preventing the passage of the chyle from the intestinal tube into the thoracic duct. Occasionally, however, this lesion of the nutritive function exists in a very high degree without any assignable cause. Who does not recollect the extraordinary individual who was exhibited in New York, a few years ago, with the soubriquet of the “living skeleton?” Calvin Edson, for such was his name, weighed but fifty-eight pounds. He was forty-two years old, five feet two inches high, and formerly weighed one hundred and thirty-five pounds. During the last sixteen years of his life, he had been gradually wasting, without any apparent disease, his appetite and health being as good as usual. In another instance of extreme atrophy of the general system, in a young Frenchman named Seurat, who was shown in London, not

long ago, the lesion seems to have been connected with imperfect alimentation, as the individual did not take more than three or four ounces of food, with a little wine, on an average in the twenty-four hours.

All animals have a period of growth, maturation, and decay. In the human subject, the body, after having reached the age of forty, begins to exhibit traces of decline, which from this time on become gradually more and more conspicuous, until the machine is literally worn out, and man “goeth to his long home.” Examined at this period, the whole mass of the brain is generally found diminished in size, the nerves have lost their moisture, and the ganglia connected with them are condensed, and considerably shrunk in volume. The respiratory system experiences similar changes: the lungs are dryish, inelastic, and increpitous, their volume is sensibly lessened, the walls of the air-cells are attenuated, and whole lobules are sometimes deprived of their vesicular structure. The muscles of voluntary life are pale, flabby, and diminished in bulk; the arteries, veins, and absorbents shrink in their diameter, and a large proportion of the more minute ones, becoming useless, are obliterated, and lost; the lymphatic ganglions are hard, small, and many of them entirely disappear; the bones are spongy, brittle, and extremely prone to fracture; the ligaments are unusually slender; the articular cartilages dry, and attenuated; and the salivary glands, together with the liver, pancreas, spleen, and kidneys, are indurated, and considerably reduced in size. In the male sex, after the functions of the testicles have ceased, absorption frequently commences in these bodies, which shrink, become soft, pulpy, and are sometimes not larger than a French bean. The cells of the penis are augmented, and their fibrous parietes very much attenuated, in some instances even partially absorbed. In the female, the ovaries are pale, shriveled, and frequently transformed into a condensed grayish substance; the mammae are soft and flabby, with scarcely a trace of their original structure; and the uterus is hard, firm, and diminished in volume.

Together with the changes of texture here described, are to be observed certain alterations in the various fluids. The digestive function being less vigorously executed than in youth and manhood, there is a less perfect elaboration of the chyle, followed by a deteriorated state of the blood which is prepared from it. Nor does the difficulty end here. On

reaching the lungs, the vital fluid, in consequence of the deranged state of the pulmonary tissue, is but partially acted on by the atmosphere, and is thus rendered unfit for the proper nourishment and stimulation of the various organs and textures of the body. The jelly, which exists in such great abundance in young persons, totally disappears in decrepitude, its place being usurped by albumen and fibrin. The various secretions are likewise modified, and every thing indicates that the blood has undergone important changes, both in its physical, chemical, and vital properties. Such is a rapid sketch of *senile* atrophy, — a state which strongly illustrates the effects of the wear and tear of the animal machine.

Local atrophy may affect an entire organ, a portion of an organ, or one or more of its anatomical elements, exist as the only lesion, or be associated with other diseases. The causes which give rise to this affection are, first, cessation of the function of an organ ; secondly, diminution of the nervous influence ; thirdly, deficient supply of blood ; and, fourthly, inflammatory irritation.

It appears to be a law of the animal economy, that, when an organ is of no further use, it gradually falls into a state of decay. Of this class of structures are the umbilical vesicle and the pupillary membrane of the foetus, the former of which, after having subserved the purpose of its creation, disappears at the close of the third month, the latter between the seventh and eighth. The kidneys are preceded in the embryo by two jelly-like parts, to which the term of Wolffian bodies has been applied, as they were first pointed out by the celebrated German anatomist Wolff. These bodies, which exist not only in the mammalia, but likewise in birds and amphibia, acquire their greatest bulk about the middle of utero-gestation, after which they gradually diminish by absorption, and at length entirely disappear. The gubernaculum, which is visible in the tenth week of embryotic life, is a thin membranous process, which guides the testicle to the internal ring, and is finally converted into cellular substance. These are instances of atrophy from the cessation of the functions of an organ in the foetus. After birth, changes not less remarkable are to be observed ; such, for example, as the wasting of the thyroid body, the supra-renal capsules, and the thymus gland. From the same cause the alveolar processes of the jaws disappear after the removal of the teeth. In the female, the ovaries shrink after the decline of the

menses ; and, in conformity with the same law, the testicles often remarkably diminish in size in monks, who lead a life of celibacy, in the strict observance of their vows.

Atrophy may result, secondly, from a diminution of the nervous influence,—a circumstance not at all surprising, when it is recollectcd how much the action of the capillaries is under the control of the cerebro-spinal axis. Whole limbs sometimes waste from this cause : in other cases, the lesion is more limited, and implies a very partial disorder of the nerves. Dr. Townsend observes, that, when the atrophy is caused by disease of the brain, it occurs much more slowly than when it is occasioned by an affection of the nerves of the part. The reason of this difference is not very obvious.

The most remarkable examples of atrophy of the extremities, are those which result from pressure on the axillary and sciatic plexuses. A few years ago, I had a young man under my care, who had received a dislocation of the humerus fifteen months before, which was permitted to remain unreduced. The head of the bone rested on the brachial nerves, and, although the limb retained a considerable degree of motion, the muscles were exceedingly soft and wasted in comparison with those of the other arm. Professor Lobstein, of Strasburgh, mentions a somewhat similar case, which he observed in a man fifty-four years of age. When a child, he was thrown down in the street, and, soon after, the right limb became exceedingly feeble, soft, and reduced in size. On dissection, all the muscles were found extremely pale, and as thin as membranes ; the gastrocnemius and soleus weighed less than three ounces, whilst those of the sound limb weighed nearly eight,—the tendo-achilis of the former being only two lines in thickness, of the latter, five. Nor was the atrophy confined to the soft parts. The right hip-bone was considerably reduced in size and thickness, and the corresponding femur weighed only three ounces, two drachms and a half, whilst that of the opposite side weighed nearly double. The nerves themselves, as well as the blood-vessels of the diseased extremity, did not seem perceptibly altered.*

Another cause of local atrophy is a deficient supply of sanguine fluid. When any part is deprived of its usual quantity of blood, it very soon becomes enfeebled, its substance is rendered pale and flabby, and at last it loses the power of

* *Traité d'Anatomie Pathologique*, t. i. p. 90.

action, although every other condition for its performance may remain unimpaired. Thus the testicle wastes after tying the spermatic artery ; and, for the same reason, the muscles of the lower extremity frequently shrink after securing the principal vascular trunk of the thigh. Atrophy of the heart is sometimes produced by ossification of the coronary vessels, and Lobstein records a case in which the spleen was not larger than a filbert, from the obstructed condition of the splenic artery. In old age, as was before intimated, many of the capillaries are obliterated ; and it is not improbable that to this circumstance is owing that diminution of the size of our organs, which constitutes senile atrophy. To the same cause is to be attributed the wasting of the lung and heart, when fluid is accumulated in the pleuritic and pericardiac cavities.

A fourth cause of atrophy, and the last that will be mentioned on the present occasion, is inflammation. The irritation excited by the presence of biliary concretions in the gall-bladder is sometimes followed by complete wasting of that organ. Hepatitis often gives rise to atrophy of the parenchymatous structure of the liver, and orchitis, especially when supervening on mumps, is not unfrequently succeeded by impotence. How the lesion is produced, in these cases, it is not easy to determine. It is probable that the chief fault is in the arterial capillaries, which cease to perform their accustomed functions, and thus allow the absorbents to carry off more than the usual amount of organic matter.

CHAPTER XIV.

Of Transformations.

The Body in a state of constant Mutation.—Number of Transformations: the Cellular, Mucous, Cutaneous, Fibrous, Cartilaginous, Osseous and Adipous.

If we trace the human body through the various stages of its existence, it will be found that it is incessantly undergoing changes, by which the nutrition of its elementary constituents is modified, until they are at length converted into totally different structures. Regarded in its primordial state, it is merely a mass of gelatine, wholly devoid of form, and floating about in the midst of a watery fluid; but, by and by, however, it loses its homogeneous aspect, assumes a more determined shape, blood is formed, organs are constructed, the animal grows, arrives at maturity, is born, and gradually accommodates itself to the circumstances which surround it. But, long ere this event occurs, certain parts have already disappeared; and the process thus begun in the womb, literally continues till the last moment of life. During infancy and adolescence, entire organs, now no longer of any use in the economy, change their character, and are either completely absorbed, or revert to their primitive condition. Thus the thymus gland, which at birth is so large as to cover the whole of the anterior surface of the pericardium, and which consists of a considerable number of distinct lobes, gradually shrinks into cellular tissues, and finally, about the age of thirty, entirely disappears.

So far as an attentive examination of the subject enables me to determine, I feel satisfied that the number of transformations is much smaller than we might be led to infer from a perusal of the works of Andral, Cruveilhier, Meckel, and other authors. Great as my respect is for these writers, and unwilling as I am to detract from their merits, I am nevertheless constrained to say that they have slurred over this branch of pathological anatomy in the most bungling and unphilosophical manner; and that they have confounded things

which, one would suppose, it was impossible not to discriminate. These remarks are more particularly applicable to the otherwise excellent treatise of Andral, who, strange as it may seem, has confounded under one general head analogous tissues and analogous transformations, than which nothing can be more erroneous, and, as far as the progress of the science is concerned, more injurious. Is this author really ignorant of the difference between these two pathological states? The idea is preposterous; and yet, from the manner in which he has grouped them together, one might really be induced to infer that this was the fact. What does the term transformation imply? Does it denote a new growth, a new formation? Certainly not; nevertheless, this appears to be the sense in which it is employed by Andral. If the word means any thing at all, and if it is to be retained in the writings of pathological anatomists, it means, and should be restricted to, those changes which a preëxisting tissue undergoes, as it is being converted into another that is totally different from it, but which has its analogue in the animal economy.

Viewed in this light, the transformations are really few in number, and may be stated as follows: 1. The cellular. 2. The mucous. 3. The cutaneous. 4. The fibrous. 5. The cartilaginous. 6. The osseous. 7. The adipous. To each of these transformations it will be necessary to devote separate consideration; and, in entering upon this duty, I shall only remark, concerning them, that they occur most frequently in old age, and that they are all effected under the influence of inflammatory irritation. How far the latter proposition is true, we shall endeavor to show as we proceed with our discussion.

The *cellular* transformation, on the whole, is much less frequent than some others that have just been enumerated. The best illustrations of it are to be found in the peritonæum, the adventitious membranes, the gall-bladder, and the ligament. The gubernaculum also affords a good example of it. This band, which is intrusted with the office of conducting the testicle from the lumbar region to the scrotum, is of a fibrous nature, which it retains until it has effected the purpose of its creation, when it gradually shrinks into cellular substance. During its descent, the organ in question likewise drags along with it a portion of peritonæum. This process forms an elongated cul-de-sac, somewhat like the

finger of a glove, which occupies the inguinal canal, lying in front of the spermatic cord, to which, and to the testicle, it closely adheres. When the descent is completed, the canal is by degrees closed up, and the portion of peritonæum alluded to degenerates into cellular tissue, whilst that over the testicle remains still a serous cavity.

The ligaments, especially the capsular, are sometimes converted into cellular substance. The metamorphosis is most marked in young persons affected with unreduced luxations of the hip and shoulder joints. In such cases it is not rare to find the ligaments of a dull white color, deprived of their fibrous arrangement, and transformed into lax cellular structures. The same thing is occasionally observed in the extremity of an obliterated artery, and in the coats of the gall-bladder, when it is obliged to suspend its functions from some permanent obstruction of its excretory duct. The adventitious serous membranes, particularly the band-like, are often transformed into cellular tissue, more frequently in the pleuritic and pericardiac cavities than in any other situations.

Considering the close connection existing between the mucous and cutaneous tissues, their similarity of organization and of function, it is not at all surprising that the one should be convertible into the other. With regard to the former, which serves to line the various outlets of the body, it has only to be exposed to the atmosphere and to repeated friction, and, sooner or later, it is transformed into *skin*, or at least into a substance so nearly resembling it, that it would be difficult to point out any difference between them. The process by which this is accomplished is gradual, and requires some time for its completion. The first thing that is to be noticed in the exposed membrane is a change of color, which progressively diminishes in intensity, until at length it approaches that of the external cutaneous surface. Whilst this blanching is going forward, the part loses its accustomed sensibility, augments in thickness and density, and becomes covered with a horny lamella, corresponding with the epidermis. Its absorbing powers are also much lessened, and, instead of mucous, it pours out a thin watery fluid, analogous to the cutaneous perspiration. This transformation, however, is at best imperfect; and it remains to be shown whether it consists of the same number of layers as the natural skin.

The cutaneous texture is the only one, it appears to me, which is, strictly speaking, susceptible of the *mucous* transformation. In order to bring this about, the process above described should be, as it were, reversed; that is to say, the skin should be inverted, and excluded from the influence of the atmosphere. Soon after this is done, the epidermis is observed to drop off, and the true skin assumes a deep, florid aspect, becomes extremely sensitive as well as somewhat rough, and deposits a thin, ropy, whitish fluid, in all respects similar to mucus. Analogous phenomena are often witnessed in corpulent persons, especially in infants, who suffer from chafes of the neck, groin, and arm-pit, from neglect of cleanliness.

Cases occasionally occur in which an opportunity is afforded for observing what is termed the *fibrous* transformation. The tissues most liable to be thus affected are the cellular, the serous, and the vascular, together with the muscular and pseudo-membranous. In whatever situation it may occur, it is in the cellular element that it probably always begins, from which it gradually extends to and involves other textures, its progress being slow or rapid, according to the nature of the affected part, and the intensity of the exciting cause.

In some instances, this transformation would seem to be of a physiological kind, taking place in parts that have ceased to perform their functions. Of this description, are the vessels which are concerned in carrying on the foetal circulation. These vessels, during intra-uterine life, are of the same structure precisely as the rest of the vascular system, of which they form so many appendages; but no sooner is the child detached from its mother, than they are rendered useless, and, instead of continuing hollow, which could answer no good purpose, they are gradually closed up, and converted into dense, fibrous cords, in which it is impossible to recognize the slightest trace of the original structure. The process which is thus at work is of an inflammatory character, and serves the double purpose of closing these superannuated vessels, and metamorphosing their tunics.

Next to the osseous, there is no transformation which is of such frequent occurrence as the *cartilaginous*. This usually appears in the form of thin plates or nodules, which possess all the properties, both physical, chemical and vital, of the tissue from which they obtain their name. Of all the tex-

tures, the subserous cellular seems to be the one that is most subject to this species of transformation. It is also frequent in the fibrous envelopes of the spleen, especially in the inferior animals, in the placenta, the gall-bladder, the parietes of accidental cysts, in adventitious membranes, and in the walls of abscesses and of tuberculous excavations.

The cartilaginous transformation is sometimes seen in the subcutaneous cellular tissue. An instructive case of it is related by Andral, which he observed in a female who died of elephantiasis in the Charity Hospital at Paris. Underneath the skin of one of the inferior extremities, in the place formerly occupied by the muscles, which were reduced to a few pale fibres, was an enormous mass of hard, condensed, cellular substance, possessing all the ordinary properties of cartilage. Is this case one of real metamorphosis, or ought it not rather to be regarded as one of new formation? The latter supposition, I think, is the more plausible of the two.

Still more rarely is the cartilaginous transformation observed in the submucous cellular tissue. Hitherto I have not met with a single well-marked example, and Andral states that he has witnessed it but once. The new substance seated beneath the mucous lining of the stomach, cut precisely like a piece of costal cartilage, and passed by insensible gradations into the circumjacent cellular tissue, which was unnaturally thick and indurated.

The fibrous transformation, like most others, passes through several stages before it attains its perfect developement. "In the pleura, for instance, it is by no means uncommon," says Andral, "to observe spots in which the cellular tissue is condensed and indurated, but still retains its natural organization; others in which it is become evidently fibrous; and, lastly, others in which it presents merely a homogeneous white mass, the texture of which is perfectly analogous to that of cartilage." *

The most common transformation, by far, is the *osseous*. Although it has been described as occurring in all the tissues, even the nervous and the muscular, it is now well ascertained that it is confined exclusively to the cellular, fibrous, fibro-cartilaginous, and cartilaginous,—the frequency with which it takes place being in the order here enumerated. The new substance, which often bears but a very faint

* Treatise on Pathological Anatomy, by Townsend and West, vol. i. p. 206.

resemblance to natural bone, makes its appearance under three principal varieties of form, — the lamellated, tuberoïd, and spicular. Of these the first is the most common. It is usually met with in the subserous cellular tissue of the chest, abdomen, cerebro-spinal canal, and the testicle, and occasionally forms patches of considerable size, of a pale yellowish color, and from the third of a line to the twelfth of an inch in thickness. It is also seen in the walls of accidental serous cysts, in the interior of fibrous tumors, in the thyroid gland, and in the coats of the arteries. When the patches are numerous, they sometimes coalesce, and thus form a sort of osseous membrane. In this manner I have often seen the largest arteries converted into hard, rigid tubes; and I have a specimen of diseased thyroid gland, which is reduced to a perfect bony shell, the interior being occupied by a soft, cretaceous substance.

The second variety, the tuberoïd, is most common in the brain, the parenchymatous organs, and in the interior of serouscavities, whether natural or accidental. The number of concretions, although sometimes considerable, is generally small, not exceeding ten or fifteen. In the lungs as many as five or six hundred have been found in a single subject. Varying in size between a clover-seed and a walnut, they are seldom larger than a cherry-stone, are usually of an irregularly spherical shape, sometimes oval or even angular, more or less brittle, and of a pale straw-color: in some instances, they are perfectly smooth, and of a pearly opaline lustre. Whether occurring alone or in groups, they are either enclosed by distinct cysts, or they lie in immediate contact with the tissues or cavities in which they are formed.

Instead of occurring in plates or granules, the accidental substance occasionally appears in the form of little *spicules*, resembling so many stalactites. Varying in length, from a few lines to an inch or more, they are rarely thicker than a crow-quill, and are most commonly met with in the subserous cellular tissue of the brain and spinal cord, in the periosteum, and in the cellular tissue between the muscles. This variety, on the whole, is much less frequent than either of the other two.

With respect to its consistence, the osseous tissue, if it be really entitled to this appellation, is subject to much variety. In the great falx of the dura mater, I have frequently found it as dense and solid as the petrous portion of the tem-

poral bone; in most other situations, however, it is much softer, and often remarkably brittle. In its structure it may be either homogeneous, radiated or reticulated; but nowhere, so far as I have been able to observe, does it present an internal cavity corresponding with the medullary canal of the long bones. Chemically examined, it is found, like the original osseous tissue, to be composed of the phosphate and carbonate of lime, in combination with gelatine. The relative proportions of these constituents are extremely variable, and it not unfrequently happens that one of them is totally absent.

It has been already seen that the osseous transformation is most common in the cellular tissue. This tissue, however, is not equally liable to suffer in all parts of the body. It is seldom witnessed in the subcutaneous cellular tissue, whilst it is very frequent in that of the muscles, and still more so in that of the serous membranes, especially in that of the arteries and of the left side of the heart. The submucous cellular tissue appears to be almost exempt from this transformation; at all events, I have never seen an instance of it; and this accords with the experience of Andral, and other writers. The fibrous membranes, the cartilages, and fibro-cartilages, are rarely affected except as the consequence of old age, and, what is remarkable, the latter are generally much more frequently involved than the two former, out of which they are constructed, and between which they form the connecting link in the textural scale.

Is the osseous transformation always preceded, when it takes place in the cellular tissue, by the fibrous and cartilaginous states? Upon this point pathological anatomists are still at variance. If the process be carefully examined, as it occurs in the subserous cellular tissue in different parts of the body, it will be found that it involves a series of successive stages corresponding with those that are observed in the ossification of the foetal skeleton. The first change which this substance experiences is a diminution of its natural transparency, accompanied with a slight degree of thickening of the part, and a deposition of turbid, cream-like matter, which is diffused through its areolar texture. As the morbid process advances, the part becomes more and more opaque, is rendered flexible and elastic, assumes a grayish color, and grates under the scalpel. It is now distinctly fibro-cartilaginous; it is next converted into cartilage, and finally into bone, the particles of osseous matter being deposited at different points,

which gradually augment in diameter, and at length, running into each other, thus completely change the primitive character of the part. The period required for the perfection of each of these changes cannot be determined: in some instances there is reason to believe that it is very short, whilst in others it embraces several months, or even years.

Such, in a few words, is the process which nature ordinarily employs in order to accomplish this transformation. I say ordinarily, for there are cases, as every one must be sensible, in which the process is much less complicated, and in which the osseous matter is deposited without any antecedent alteration in the structure of the part. This mode of ossification is most common in the cellular tissue of the arteries, and in that of the valves in the left side of the heart: it is also occasionally seen in the parietes of serous cysts, and in the cellular tissue of the muscles.

Accidental ossification is frequently an effect of old age. There are very few persons, beyond the fiftieth year, in whom the arteries, to say nothing of the mitral and aortic valves, together with the costal and laryngeal cartilages, are not thus affected, and this often to a surprising extent. In other cases, it is directly chargeable to inflammation, sometimes of an acute but mostly of a chronic nature. The ossification of the pleura in pulmonary phthisis, of the vaginal tunic in old hydroceles, and of the arachnoid in chronic hydrocephalus, is unquestionably to be referred to this cause and to no other. So also with regard to the ossification of the periosteum during the formation of callus, of the walls of old abscesses, and the linings of tubercular excavations of the lungs. How far the examples of senile transformations above adverted to are influenced by, or unconnected with, inflammation, is a question concerning which we have no positive information. For my own part, I am disposed to believe that it is not altogether absent even here, although it may not be characterized by the phenomena that physicians are in the habit of ascribing to it.

The most remarkable transformation, perhaps, of all, is the *adipous*, concerning which very little appears to have been known until within the last fifteen or twenty years. Notwithstanding the great attention that has been bestowed upon it by some of the European pathological anatomists, it must be acknowledged that we are still entirely in the dark, both as respects its intimate nature and its exciting

cause. By some the alteration is supposed to consist essentially in the superaddition of fatty matter to the existing tissues, whilst others consider it as the result of a true transformation, the same in principle as the fibrous, cartilaginous, or osseous. Whatever doubts may still exist upon the subject, it seems to me that both views are, to a certain extent, correct. At all events, my own observations have fully convinced me, that there are cases in which the fatty matter is literally infiltrated into the interstices of the different organs, imparting to them a greasy color and consistence. On the other hand, I am equally certain that a transformation, properly so called, of this kind takes place in different structures, especially in the liver, kidneys, pancreas, heart, and muscles, — parts in which it is most frequently witnessed. An organ that is thus affected, is generally of a pale straw-color, diminished rather than increased in consistence, is easily torn, receives the impression of the finger, greases the scalpel which is used in cutting it, is of lighter specific gravity than in the natural state, and contains from one third to one half its own weight of yellow concrete oil. Such are the changes which ordinarily attend this transformation, and the question now presents itself, — how are they brought about? In the liver of the inferior animals, as will be shown in another place, this degeneration can often be produced at will, simply by subjecting them to rest in a dark apartment, and cramming their stomachs with rich, stimulating food, which, by creating obstruction in the portal circle, in all probability induces inflammation in the hepatic tissues. In the human subject, it is occasionally connected with general hypertrophy of the adipous tissue, and instances have been observed in which it appeared to depend upon the want of exercise of the affected part. The latter opinion is entitled to consideration chiefly from what occurs in the muscles of the inferior extremities of old persons who have for a long time labored under paralysis. In such cases, the muscles often assume a pale color, are remarkably soft and flaccid, and exude a clear, oily fluid, on pressure, their fibres, however, remaining perfectly distinct. But are these effects really attributable to the repose in which these parts, under these circumstances here referred to, are placed? Would it not be more philosophical, in the absence of more satisfactory evidence, to conclude that something was due to the want of nervous influence, and to the

altered state of the circulation thence arising? Be this as it may, I feel perfectly convinced, in my own mind, that the transformation in question, like the cartilaginous and the osseous, indeed, like every other, is uniformly the result of inflammatory irritation. The subject, however, requires to be further investigated, and, until this be done, it will be well enough to avoid all speculation concerning it.

The preceding subjects might all have been extended much further, but what has been already said must suffice. In discussing the pathological anatomy of the various tissues and organs, ample opportunity will be afforded me for supplying deficiencies, and entering into details which could not well have been noticed in the present section.

CHAPTER XV.

Of Hydatids.

Historical Outline.—Where found.—Classification of Hydatids.—The Cysticercus, Polycephalus, Diceras, Echinococcus, and Acephalocystis.—Their Origin and Organization.—The manner in which they are nourished.—The Changes which they experience by Age, and the Alterations they induce in the Organs in which they are developed.

THE combined researches of naturalists and pathologists have fully shown that many of the higher orders of animals, as well as some of the lower, are infested with a class of beings which are generally known, at the present day, by the name of hydatids. The account of these singular bodies by the ancients is extremely slender and imperfect; nor did the scanty stock of knowledge which they left us receive much accession until after the middle of the last century. Since that period much light has been thrown upon the history, developement, and organization of the different kinds of hydatids, principally by the researches of Rudolphi, Zeder, Laennec, Ludersens, Cuvier, and Cloquet, the latter of whom published a very lucid and elaborate article on the subject, in 1818, in the French Dictionary of the Medical Sciences. Much, however, as these distinguished anatomists have done, it must be confessed that there are a great many interesting circumstances concerning which we are still in complete uncertainty. In this country the subject can scarcely be said even to have begun to attract the attention of the physicians; indeed, I venture to affirm that there are not fifty members of the whole American profession who have any knowledge of it.

Hydatids occur in the serous cavities, the alimentary canal and the passages which open into it, the cellular tissue, between the muscles, and in the proper substance of the different organs. Nevertheless, there are, as will be seen hereafter, some parts that are more frequently affected than others. They have been found in nearly all classes of animals,—in birds, reptiles, and fishes, as well as in a great many of the

mammalia. Whether they exist in insects, is a point which has not been ascertained. No period of life is exempt from them. Portal, indeed, mentions an instance of their having been detected in the foetus. They are most common, however, in adults and old people.

So far as can be ascertained, these parasitic beings possess no genital organs, no apparatus for respiration, no trace of a circulation, and apparently no nerves. They can live and propagate their species only in the interior of other animals, and their existence is usually very brief, most of them perishing within the first year or two after they are developed, often much earlier. A few of them only are capable of performing distinct movements, under the influence of external stimulants. The *cysticercus*, for example, when put in luke-warm water, not only whirls itself about, but alternately protrudes and retracts its suckers. The *acephalocyst*, on the contrary, remains perfectly quiescent, and may therefore be said to be void of irritability and contractility.

In describing these singular animalcules, I shall divide them, with Cloquet and others, into five genera: 1. the *cysticercus*; 2. the *polycephalus*; 3. the *diceras*; 4. the *echinococcus*; and, 5. the *acephalocystis*. Differing from each other in many essential points, it will be necessary to devote to each of these genera a separate consideration. It may be premised, however, concerning them, that they all consist of a thin, pellucid vesicle, varying in size between a clover-seed and an orange, which is filled with a clear, watery fluid, and surrounded by a dense, fibrous capsule, upon which they depend for their nourishment and support.

The *cysticercus* is nearly cylindrical in shape, terminating behind in a caudal vesicle, whence its name. The whole animal is somewhat wrinkled, and its head, which strongly resembles that of the tape-worm, is furnished with hooks and suckers. This genus is more frequently met with in the inferior animals than in man, and is particularly common in the liver and brain of the sheep. Its size rarely exceeds a small walnut, and in most cases it is not near so large. It generally exists singly in the enclosing cyst, which is almost always thin, delicate, and transparent, except in old cases, or where the hydatid has lost its vitality, when it is apt to be thick, dense, semi-cartilaginous, or even bony. In the sheep, in which this genus often acquires a large size, the caudal vesicle presents an infinite number of minute elevated lines, running nearly at right angles with the body of the

animal. Five species of the cysticercus have been recognized by authors,—the cellular, vesicular, dicystic, speckled, and Fischerian.

The cellular cysticercus (see Figs. 1 and 2) is met with almost exclusively in the hog, in which it occasions the disease commonly known under the name of *measles*, or what the German writers call *finnen*. It has been observed but once or twice in the human subject. The body is conoidal, from four to ten lines in length, and composed of a thin, transparent membrane, without any perceptible fibres: the caudal bladder is of an oval shape, and the head, which is tetragonal, is furnished with four suckers, together with thirty-two hooks divided into two rows.

The vesicular species, which is also very rare in man, having been found only in a single instance, in the choroid plexus of an apoplectic subject, has hitherto been chiefly observed in the ox, sheep, swine, goat, stag, and gazelle. The peritonæum, the pleura, and the arachnoid, are the situations in which it delights to dwell. Its head, which is almost tetragonal, is armed with a cylindrical and slightly curved snout: the neck is quite short, the body small, and the caudal vesicle nearly spherical. Such are its distinguishing features.

The third species is the dicystis, or, as this term literally signifies, the double-bladder hydatids. Laennec is the only person who has observed this worm. He found it in the lateral ventricles of a man who died of apoplexy. It consists of two large vesicles, of which one is caudal, whilst the other, which is annulated and of a conical shape, forms the body. Both are traversed by a wide canal, which terminates anteriorly in a cul-de-sac. The head has four suckers, and a certain but undeterminate number of hooks.

The speckled cysticercus has a head with one sucker and

Fig. 1.*

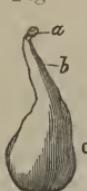


Fig. 2.†

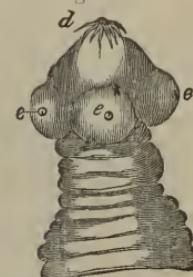


Fig. 3.‡



* *a*, the head; *b*, the neck; and *c*, the dilated vesicular tail.

† Magnified head of the same: *d*, the proboscis; *e*, *e*, *e*, the suctorial discs.

‡ A portion of human muscle, with the cysticercus: *a*, the cyst cut open; *b*, the parasite; *c*, the muscle.

six hooks; the body is conical, nearly transparent, and from four to eight lines long; the caudal bladder is spherical, and irregularly dotted with very small white points. It has been met with only in one instance, by M. Treutler, in the choroid plexus of a young woman.

The Fischerian species, the fifth and last which I shall describe, has a rounded, slender, annulated body, and a large head furnished with an indeterminate number of hooks and suckers. The caudal bladder, which is pear-shaped, is about the fourth of an inch long, and terminates in a small point, which adheres to the organ which the animal inhabits. It is said to have no enclosing cyst. Dr. Fischer, of Leipsic, after whom it is named, detected it twice in the choroid plexus of the human subject.

The second genus, the *polycephalus*, is extremely rare, and has not, up to the present time, so far at least as I am aware, been found in man. It is composed of a semi-transparent cyst, speckled with minute, opaque, whitish spots, of a somewhat oval figure, is generally very small, and is provided, as the derivation of the name indicates, with a great number of heads. The situations which it generally occupies in the inferior animals are the brain, the liver, and the intermuscular cellular tissue. Two species have been noticed by authors, the *cerebral* and the *granular*, which, however, as they never occur in the human subject, need not be described.

The *diceras*, a genus established by Sulzer, infests the alimentary canal of animals, and also occasionally that of the human subject. The German author here mentioned, first observed it in the alvine evacuations of a young woman after having taken some purgative medicine. This genus, which embraces only one species, the *rough diceras*, is distinguished by its flat, oval body, which is about a line and a half long, and terminated in a point posteriorly, and by the rough, bifid horn which surmounts its head, and from which the animal derives its name. It is loosely enclosed by a capsule. As yet it has not been discovered in the substance of any of the viscera. Of the diceras, I have never seen any specimens, and suspect that it is extremely uncommon. Rudolphi, indeed, appears altogether to doubt its existence, whilst others suppose that it may be a variety merely of acephalocysts, presently to be described.

The fourth genus is the *echinococcus*, (Figs. 4 and 5,) first suggested by Rudolphi, but not admitted by Cuvier. Occurring principally in the brain, liver, spleen, and omentum, it consists

of a capsule, analogous in structure to that of the acephalocyst, attached to the inner surface of which are numerous animalcules, of an ovoidal shape, extremely fine, granulated, and provided with four suckers and a crown of hooklets. The echinococcus is very rarely found in the human subject. Zeder discovered some in the brain of a young woman, occupying the third and fourth ventricles: they were about twelve in number, pyriform, and quite small. Müller has recently described an instance in which they were voided with the urine, by a man laboring under renal disease. But the most extraordinary case, perhaps, on record, is that published by Rendtorf. The sac

containing the hydatids was developed in the brain: it was of large size, and weighed upwards of two pounds. The walls of the right ventricle, in which it was situated, were so attenuated as to be scarcely a line and a half in thickness. It

should not be forgotten, that the name by which this genus is designated has reference to the rounded form of the body, and to the little asperities which cover it.

The fifth genus, the *acephalocystis*, (Fig. 6,) by far the most interesting and common of all, was founded by the celebrated Laennec, who published a very accurate account of it, in 1804, in his excellent "Memoir on Vesicular Worms." Occurring both in the human subject and in many of the inferior animals, the individuals of this class of parasites infest some organs much more frequently than others. They seem to have a remarkable predilection for the liver, owing, probably, to some peculiarity of structure favoring their development. The brain, ovary, uterus, mammary gland, spleen, and kidney, are also sometimes their

Fig. 4.

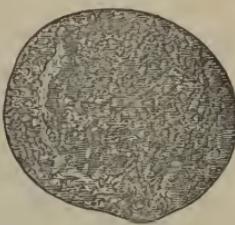


Fig. 5.

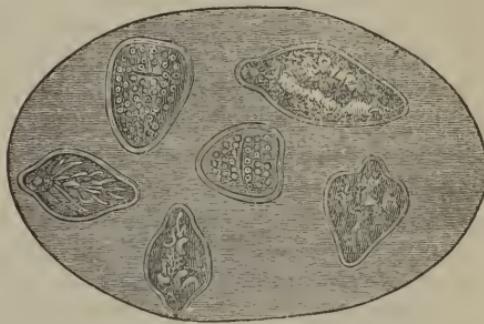


Fig. 6.



seat; in fact, they have been found in every part of the body, except the alimentary canal, the urinary bladder, and the respiratory passages.

Varying in size between a mustard-seed and a large orange, they are generally of a spherical figure, and composed of a white, semi-opaque, pulpy vesicle, filled with a clear, limpid fluid. This vesicle, which forms the hydatid, properly so called, is from the sixth of a line to the eighth of an inch in thickness, and is often separable into two or more layers, and is so exceedingly delicate as to yield under the slightest pressure of the finger. So weak is it, indeed, that it is frequently incapable of withstanding the pressure even of its own contents, as I have had repeated opportunities of witnessing, after the partial removal of the enclosing cyst. On being ruptured, it shrinks up into a soft, irregular, pulpy mass, of an opaline color, which readily swims in water, and bears the greatest resemblance to coagulated white of egg. M. Collard, a French chemist, who has recently examined this substance, states that it consists of two principal ingredients, one of which is essentially albuminous, whilst the other, the precise nature of which is not known, has a considerable analogy with mucus.*

To the inner surface of the vesicle now described are often attached extremely minute bodies, (*a* and *b*.) not bigger than the finest grain of sand, of a grayish color, and a spherical shape, which are supposed to be young hydatids. In some instances they are said to be connected with the exterior of the parent sac; but this, I presume, is very rare, and I have never seen an example of it. It has been made the basis, however, of the division of acephalocysts into two species, the endogenous and exogenous, the former being most common in the human subject, the latter in the ox and other ruminant animals. In what manner these animalcules originate, how they are attached, or at what time, after their formation, they are cast off, are circumstances in their history, concerning which we are still perfectly in the dark. All that is known with any certainty is, that they may often be seen floating about in great numbers, while they are scarcely the two hundredth part of an inch in diameter, which would lead us to infer that they are generally detached at a very early period of their existence. When the hydatid consists of several coats, as often happens, the generation sometimes takes place be-

* Dict. de Medicine et de Chirurgie Pratiques, art. *Acephalocystis*, 196.

tween them, or even in their substance. In whatever way it be accomplished, a small opaque elevation, easily distinguishable by the eyes, usually indicates the spot where the young have been developed.

It sometimes happens, though not very often, that a large acephalocyst contains several that are smaller, one within the other, all of the same shape and structure. As many as three, four, and even five, have been found thus enclosed, like so many pill-boxes. This arrangement, which occurs much oftener in the human subject than in the inferior animals, is explained by the endogenous mode of generation previously adverted to, by which one acephalocyst, after having arrived at maturity, produces another, each successive one being smaller than its parent.

The enclosing cyst of this species of hydatid is usually semi-transparent, very strong and dense, and has no connection whatever with the parasite within. In fact, there is usually interposed between them a soft, pulpy, dirty-looking substance, arranged in a thin, unequal lamella, which is regarded, by Dr. Hodgkin, as a sort of excrementitious secretion, furnished by the hydatid itself.* The thickness of this outer capsule varies a good deal with the size and age of the tumor: it can be separated occasionally into several layers, and may be said to possess all the properties of the fibrous tissue, without any of its linear disposition.

Professor Cruveilhier, of Paris, who has written an able article on acephalocysts, in the French Dictionary of Practical Medicine and Surgery, divides them into two species, the solitary and the social,—a distinction which he appears to regard as of no little practical importance. The first variety is of most frequent occurrence in animals, and is rarely developed singly, or only in one organ. In the sheep and the ox it has been found simultaneously in the lungs, the spleen, the heart, brain, and kidneys. The social hydatid, on the other hand, is not common in man; and seldom co-exists in several viscera, or in several parts of the same organ. The structures in which it is most frequently developed are the ovary and the uterus, where hundreds, nay thousands, from the volume of a clover-seed to that of the fist, are occasionally found wrapped up by one common pouch. Against this division there can be no particular ob-

* Lectures on the Morbid Anat. of the Serous Membranes, p. 187. London, 1836.

jection, provided it be borne in mind that the distinction rests solely upon the manner in which the hydatids are isolated or grouped together, not upon any difference of form, texture, or organization.

Such is a rapid sketch of the most common genera and species of hydatids. Let us now inquire briefly into their origin, their organization, the manner in which they are nourished, the changes they experience from age, and the alterations they induce in the tissues in which they are developed.

With regard to the origin of hydatids, all is doubt and conjecture. The idea of Vitet, adopted by Iverger and others, that they are the result of inflammation, although not generally embraced by pathologists, seems, on the whole, less objectionable than any other that has yet been suggested. This opinion derives considerable plausibility from what occurs in the inferior animals. In many ruminants hydatids may be produced, almost at pleasure, by confining them in moist situations and restricting them to very juicy, unripe vegetables. Cruveilhier informs us that, during several years in which he resided at Limoges, in France, comparatively few cattle were killed there that had not acephalocysts in the liver, lungs, or some other organs; and in Cincinnati, where there are annually slaughtered upwards of one hundred thousand hogs, probably not a tenth part are free from this disease. Whole droves, consisting of three or four hundred heads, are sometimes thus affected. These animals, most of which are young, are raised in the prairie districts of Ohio, Indiana and Kentucky, and are literally stuffed, for six or eight weeks before being sent to market, with fresh corn. The consequence is, that the portal circle is kept in a state of constant congestion, which finally leads to inflammatory irritation and the development of acephalocysts in the liver and other viscera. The irritation thus set up is of a specific nature, and is followed by the deposition of a fibro-albuminous substance, or, what is the same thing, a sort of plastic lymph, the particles of which arrange themselves in such a manner as to create an inferior being, an entozoic parasite.

Whilst this formative process is going forward, the parasite takes care to isolate itself from the parts in which it is developed by means of a capsule, which surrounds and protects it from injury. This capsule is supposed, by Dr. Hodgkin and others, to be derived from the circumjacent cellular tissue, — an opinion respecting which I feel myself obliged to dissent, as

being no less unphilosophical than unsupported by facts. Were there no other reason, the circumstance that hydatids are often found where there is almost an entire absence of this substance, would be sufficient to convince any one of its fallacy. Whilst there is a possibility that the opinion may sometimes hold good, it is certain that, in the great majority of cases, the capsule is a new formation, as much as the parasite itself, both being developed simultaneously out of the same substance, the only difference between them being the manner in which the particles of each are grouped together. This point may be illustrated by what occurs in an abscess of the liver. When the matter is deep seated, especially when it is considerable, there is usually an effusion of lymph, by which a sac is formed, provided with all the necessary appurtenances of organization.

This external, adventitious envelope, formed, as we have just supposed, out of the plastic lymph of the blood, is furnished with appropriate vessels, as well as, in all probability, with nerves and absorbents. Many of these vessels are of large size, can be readily injected, spread out in beautiful arborescent lines. So far as I have had an opportunity of examining them—and I have often done this in the acephalocyst of the hog—they appear to me to be derived principally from the surrounding textures. Nevertheless, there are certain situations in which they are plainly the result of new formation, as in the ventricles of the brain, the serous sacs, the ovaries, and the uterus. Nowhere can any of their branches be traced from the outer covering into the walls of the hydatid itself. The reverse of this has, I know, been asserted by authors, but without, there is reason to believe, any foundation in truth.

The proper hydatid contains, as was before intimated, a thin, aqueous fluid, which, as long as the animal remains healthy, is generally perfectly clear and limpid, like the purest spring-water. Under opposite circumstances, it is frequently turbid and discolored, or it is entirely replaced by purulent matter, blood, or other substance. Be this as it may, the fluid is usually remarkably saline in its taste, possesses little or no odor, and rarely, if ever, coagulates by exposure to heat, or on the addition of alcohol, corrosive sublimate, or the dilute acids. In several experiments which I made on the contents of some very large acephalocysts found in the liver of the hog, heat produced not the slightest change; and similar results ensued in a trial which I made

on a hydatid taken from the same organ of a man forty years old. These results accord with the researches of Marcell, Cruveilhier, and other writers; and they point out the great resemblance of the fluid in question, to that of hydrocephalus, in its want of coagulability, in consequence of the almost total destitution of albumen.

As hydatids, then, do not possess any vessels, so far at least as we can discover, whence is the fluid just mentioned derived, and in what manner are these parasites nourished? Deeply interesting as these questions are, we must acknowledge our utter inability to give a satisfactory or even a plausible answer to them. Is there any animal, however minute, which furnishes a secretion, and yet is destitute of vessels? If there be, I must confess I am not acquainted with it: the very idea, it seems to me, involves an absurdity. That the fluid in question is the product of the hydatid itself, no one can doubt, for it could not be derived from any other source; and, if this be admitted, it is obvious that it must be the result of vascular action. But it may be said that the fluid is secreted by the containing capsule, and that it finds its way into the proper cyst by a sort of endosmose. The only circumstances which at all countenance this supposition, are some experiments performed by Professor Cruveilhier, of Paris, and Mr. Owen, of London, in which, on placing recent acephalocysts in a colored liquid, they found that little streams of it were gradually transmitted through the parasites, so as to mingle with their contents. These researches, however, besides being incomplete, only prove that this phenomenon may take place here as in other parts, without showing in any wise that the fluid is thus actually imbibed by the animal in the natural state.

Let us now recur to the question,—how are hydatids nourished? or, rather, whence do they derive the materials necessary for this purpose? It has been already seen that these entozoa are completely isolated from the tissues in which they are developed by means of a capsule which has no immediate connection with them; and the inner surface of which, moreover, particularly in the acephalocystic genus, is generally lined by a thin, pulpy, fragile lamella, which adds still further to the insulation. This intervening substance has been supposed, by Dr. Hodgkin, to be a sort of excrementitious secretion from the hydatid itself: I should presume that it was an important structure, and that it was designed to assist in the elaboration of a fluid for nourishing

the parasite. This fluid, which is probably of a sero-albuminous character, is furnished by the vessels of the enclosing capsule, is filtered through the soft, pulpy matter here adverted to, and is finally imbibed by the proper cyst of the hydatid, which it thus enables to live and to execute its humble functions, — those, namely, of secreting a thin, watery liquid, and of propagating the species. Much of all this, of course, is conjectural ; nevertheless, most of the arguments might be sustained by analogy ; and this is the only kind of proof that can ever be adduced in illustration of an inquiry environed by so many difficulties.

Many hydatids appear to enjoy but a short period of life. This is especially true of the acephalocysts of some of the inferior animals, as the sheep and swine, in which they are said to be produced in the spring, and to perish the following winter. In others, again, as well as in the human subject, they live for years, and often acquire a very large size. The duration of their existence is greatly influenced by the nature of the tissues in which they are developed, and by various other circumstances which will readily suggest themselves to the reader. Not unfrequently an old hydatid is destroyed by its young, which press upon and finally rupture it. In a second series of cases, death comes on without any assignable cause ; the contained fluid gradually disappearing, and the proper cyst, as well as the enclosing capsule, becoming collapsed, opaque, corrugated, and of a yellowish amber color. In a third series the parasite is attacked with inflammation. When acute, this disease sometimes ends in a species of gangrene ; but more generally it leads to suppuration. Of both these terminations I have had occasion to observe a considerable number of instances. In the former case, the fluid is of a turbid appearance, and the cysts, both proper and adventitious, are converted into a soft, brownish mass, which is sometimes quite offensive. In the latter, that is, when the inflammation ends in suppuration, the contained liquid is often entirely absorbed, its place being occupied by a yellowish, gold-colored pus, of a thick, plastic consistence, slightly saline to the taste, and of a faint animal odor. This occurrence is most frequently witnessed, according to my own experience, in old acephalocysts, and in most of the cases that I have examined the internal membrane was either wholly destroyed, or broken up into fragments, which were mixed with the abnormal secretion.

When the inflammation is of a chronic kind, it is not un-

common for the enclosing capsule to become thickened, indurated, and fibrous, from the deposition of lymph. Occasionally it puts on exactly the appearance of the interior of a large aneurismal sac ; and cases have been observed where it was rendered eartilaginous, and even bony. The ossification usually begins by a few central points, which gradually augment in diameter, until, in some instances, they coalesce with each other, and form considerable sized patches.

A hydatid has been known to be the seat of apoplexy. The only instance of this kind that I remember to have read of, is that mentioned by Dr. Hodgkin, in his morbid anatomy of the serous membranes, as occurring in a man forty years old. The hydatid was seated in the neighborhood of the spleen, and was externally of a dark color, which arose from a thin layer of blood that was interposed between the proper and the enclosing cyst.

Hydatids may prove mischievous in two ways ; first, by their great number, and, secondly, by their large size. In either case, they are apt, sooner or later, to excite inflammation in the parts in which they are situated, which may terminate in suppuration, in softening, in gangrene, in induration, or, finally, in ulceration. The hardest structures are sometimes incapable of withstanding their progress. Thus, Andral records a case in which they perforated the scapula. When seated in the abdominal viscera, they are often passed by stool, ejected by vomiting, or discharged externally through a fistulous aperture. In the lungs, hundreds are sometimes coughed up by the same patient ; and in the kidneys they have been known to be voided with the urine, either entirely, or in small fragments. In the brain, they may become a source of epilepsy, paralysis, or destructive softening ; and, in the serous cavities, their escape is occasionally attended with fatal inflammation.

I need scarcely allude here to the doctrine of Adams, Baron, and others, that hydatids are essentially connected with the origin of tubercles and carcinoma. This theory, to which I shall particularly advert in another page, was founded on the frequent coexistence of these diseases in the cow, sheep, and hog, — a circumstance which is very rarely witnessed in the human subject, and which has led to the general abandonment of the views of the distinguished writers above named.

CHAPTER XVI.

Of Serous Cysts.

Have the form of shut Sacs.—Organs in which they are most frequently found.
—Classification : the simple, multilocular, and the included.—Nature of the contained Fluid.—Are either new products, or formed out of the preexisting Textures.—Are liable to Inflammation and its consequences.

MUCH more simple in their structure, as well as much less obscure in their mode of origin, than hydatids, are those membranous pouches which have received from the morbid anatomists the name of serous cysts. Deriving their generic distinction from their contents, which are usually of an aqueous character, they constitute a class of adventitious textures, which, like those naturally existing in the splanchnic cavities, form perfectly shut sacs, rough and adherent on one surface, smooth and in contact with a fluid on the other. Their shape is globular, ovoidal, pear-like, or pediculated, and in size they observe every intermediate degree between a grain of mustard and a large melon. As far as can be ascertained, they are the result, with few exceptions, of an entirely new formation, dependent upon the effusion and organization of plastic lymph. With the mechanism of this creative process, as with that of hydatids and other accidental growths, we are altogether unacquainted ; nor is it possible always to appreciate the different morbid lesions which precede and accompany it : that it proceeds, however, under the influence of causes which excite inflammation in the normal tissues, is a fact that is borne out both by observation and analogy, and concerning which it would therefore be absurd to entertain the slightest doubt.

Like hydatids, with which they are often confounded, serous cysts are found either upon free surfaces in natural cavities, or in the substance of the organs. They have been observed in almost all classes of animals ; and, although no period of life can be said to be exempt from them, yet they are much more frequently seen in the old than in the young,

and, according to my own experience, in the female than the male. Like hydatids, they may be considered as a species of parasites that live at the expense, and in the interior, of other beings, more perfectly organized than themselves, which afford them protection, and the means of subsistence. Their occurrence is extremely common, both in man and in ruminating animals; and it has even been contended that they occasionally manifest a hereditary tendency, the greater portion of a large family having been known to be thus affected during several successive generations. They have been found in nearly every structure and cavity of the body, but particularly in the ovaries, the liver, kidneys, the mammae, and the testicles. They are also not unfrequent in the brain of old persons; but very seldom have they been seen in the spleen, heart, lungs, or pancreas. In the vessels, the fibrous membranes, ligaments, cartilages, and mucous outlets, they have not, I believe, been noticed.

Viewed in reference to their structure, these adventitious sacs may be divided into three classes,—the simple, the multilocular, and the included. Before we proceed to speak of these in detail, it will be proper to offer a few remarks concerning their contents. Like the natural serous membranes, the sacs in question, when once formed, or even whilst they are in progress of developement, enjoy a life of their own, and are susceptible of various morbid actions, either set up in their substance or propagated to them from the surrounding normal textures. So long as they remain healthy, or in the exercise of the functions which nature has assigned to them, the fluid which they secrete, and which occupies their interior, is of a thin, watery consistence, clear and limpid, somewhat saline in its taste, and more or less coagulable by heat, alcohol, or acids. As to quantity, it must vary, of course, according to the size of the morbid growth, in every gradation, from a single drop to many ounces or even quarts. When affected with disease, the contents of the cysts are differently altered, and, what is remarkable, often present appearances which are not to be observed under similar circumstances in the normal serous textures. The most interesting of these changes will be adverted to in another paragraph.

The simple cyst, the type of the whole series, consists of a thin, delicate sac, generally of a globular figure, the interior of which, in the healthy state, is occupied by a pellucid fluid possessing all the properties of the serum of the blood.

Composed of a single lamella, it is usually perfectly transparent, seldom bigger than an orange, and is supplied with very long, slender vessels, which are evidently derived, in all cases, from the circumjacent parts. It is from these vessels, which are often extremely numerous, and spread out in the most beautiful arborescent manner, that the cyst obtains its nutriment and the materials from which it prepares its contents. They are accompanied, very probably, by nerves and absorbents; but these, if they exist, are so excessively minute as to elude our closest scrutiny; for no anatomist has ever succeeded, I believe, in tracing them. The parts in which this variety is most frequently developed are the internal organs of reproduction of the female, particularly the ovaries and the fimbriated extremities of the fallopian tubes, the liver, and the brain, in the lateral ventricles of which, along the choroid plexus of old subjects, they often occur in clusters of ten, twenty, or thirty at a time, the largest not exceeding a common currant.

Advancing a step higher in the scale of complexity, we come to the second division of our subject, the multilocular cyst. The principal difference between this and the preceding variety consists in the cellulated structure which is to be found in the former, whilst there is an entire absence of it in the latter. This arrangement, from which the present accidental growth derives its name, is produced by a variable number of membranous processes, which are attached to the inner surface of the main cyst, and extend inward so as to intersect each other in different directions. In this way numerous compartments are formed, varying in size and shape, which sometimes communicate together, at other times are perfectly distinct. The most curious circumstance connected with these chambers is, that they often contain different kinds of substances. Thus, one may be occupied by perfectly limpid serum, a second by pure blood, a third by pus, and a fourth, perhaps, by fatty, melicerous or atheromatous matter. The reason of this cannot be easily explained: we might naturally expect to find it in some difference of structure; but, in the majority of cases, no such difference exists; and we are therefore forced to conclude that the phenomenon depends upon a modification of secretion.

This variety of cyst is most commonly found in the cerebral substance around old apoplectic effusions. It is also frequently seen in ovarian tumors, and in the subcutaneous

cellular tissue, in parts which are constantly subjected to pressure, as the shoulders of porters and the knees of chambermaids. In its shape, the multilocular cyst is generally irregular, its walls are of unequal thickness, and its internal processes are often rough and uneven.

The third variety, much less frequent than either of the others, is characterized by the circumstance of the main cyst, which is commonly of an irregular shape, containing clusters of smaller ones attached to different points of its inner surface. The number of included vesicles is sometimes truly surprising, many hundreds being found in the same specimen, from the volume of a grain of mustard to that of a hickory-nut, but mostly of a globular form: they are composed each of a single lamiella, which is continuous with, and appears to be merely a reflection from, the original sac, which not unfrequently contains several series of these junior cysts. On cutting into them, they are found to be occupied, in the great majority of instances, by a serous fluid, in others by a matter resembling the white of eggs, thin starch, or a solution of gum arabic; or all these substances may occur at the same time, filling different cavities. When the interior vesicles are large or numerous, they sometimes completely distend the main cyst, rendering it rough and protuberant, and occasionally even bursting it; after which, being no longer repressed, they often grow with extraordinary rapidity.

These cysts, which I shall denominate the *included*, are apt to be confounded with hydatids; but may be readily distinguished by the fact of their being all intimately connected with the parent sac, and by the circumstance of vessels passing from the one to the other. The parts in which these cysts are most frequently met with, and in which they acquire the largest size, are the ovaries and the broad ligaments of the uterus. In most cases, as was previously stated, they are of a globular form; but it is by no means unusual for them to present a pediculated appearance, especially the binary and tertiary orders.

Thus, there are three distinct varieties of serous cysts, all referable to three general modes of formation, the first being the most simple, the third the most complicated, the other being intermediate between them. In other words, the first consists of a simple sac, filled with a serous fluid; the second, of a sac which is intersected by more or less numerous processes; and the third, of a sac which contains clusters of

smaller ones, precisely of the same shape and structure with itself.

It will be recollected that these different classes of cysts are the result, in most instances, of an entirely new formation, dependent upon a perverted state of the nutritive function. In other cases, they appear to be formed out of pre-existing textures, sometimes of a serous, at other times of a mucous nature. To the former category belong the cysts, which are so often found in the ovaries, in consequence of the enlargement of the vesicles of De Graaf; to the latter, those which are developed in the kidneys and in the female breasts, from obstruction of the excretory ducts. In these situations it is not uncommon for the adventitious growth to receive an accidental covering from the organ in which it is located. In the ovaries, for example, we accordingly find that the cyst is usually provided with very thick, dense parietes, separable into three distinct layers, the internal of which consists of the capsule of the vesicle of De Graaf, the second of the albugineous, and the third of the peritonæal coat of the organ. The same thing is sometimes observed in the spleen and liver. It is worthy of remark here, that, when the cyst is formed out of preexisting mucous membrane, as in the instances above referred to, it generally, in the course of a short period, assumes all the properties of the serous textures.

Serous cysts, whether of new formation, or constructed out of preexisting tissues, are liable to inflammation, and, when thus affected, they may present all the phenomena which characterize this disease in other parts of the body. The contained fluid, in such cases, is generally thick, turbid, and discolored, owing to the presence of substances which do not naturally belong to it. Occasionally, it has the aspect and consistence of coffee-grounds, thin treacle, or tar; and the instances are by no means unusual in which it possesses all the characters of genuine pus. A fatty matter has also been found in it, and a substance resembling cholesterine. The cyst itself may be variously affected. Generally speaking, it is opaque, grayish, dense, and fibrous, being thicker and stronger at some points than at others. The examples, I believe, are rare in which the cyst is eroded, or transformed into cartilage or bone. The alterations which it creates in the parts in which it is situated need not be particularly described, as they do not differ from those induced by hydatids.

CHAPTER XVII.

Of the Heterologous Formations.

Preliminary Observations.—Classification: Tubercl; Melanosis; Scirrh; Encephaloïd.—I. *Tubercl*.—Definition.—Great frequency.—Occurs nearly in all Tissues, and at all Periods of Life.—Is common in the lower Animals.—Chemical Composition.—Varieties of Form.—Concrete and semi-concrete Tubercular Matter.—Notions respecting its Origin, Developement, and Organization.—Softening and Excavations.—II. *Melanosis*.—Historical Sketch.—Occurs in Man and Animals.—Chemical Analysis.—Color and Consistence.—Varieties of Form.—Tissues most liable to suffer from Melanotic Dia-thesis.—States of the System which predispose to its formation.—III. *Scirrh*.—Difficulty of the Subject.—Definition.—Varieties of Form.—Chemical Constitution.—Rarely appears before the age of thirty.—Most common in Glandular Organs.—Proximate Cause.—Opinions of Adams, Carmichael, Hodgkin, and others.—Is apt to Ulcerate and involve the general System.—IV. *Encephaloïd*.—Is intimately allied to *Scirrh*.—Terms by which it has been designated.—More frequent in some Structures than in others.—Varieties of Form.—Color, Consistence, and Composition.—Organization and Mode of Origin.—A Disease of early Life.—Involves the whole System.—Termination.

By the term heterologous are understood certain morbid products, of a solid or semi-concrete consistence, which have no resemblance whatever, or, at most, only a very remote one, to the natural, normal, or preëxisting tissues of the body. It is of Greek derivation, literally signifying unlike, dissimilar, or without analogy, and is employed by many as synonymous with the word heteroclite, first devised, I believe, by some of the German anatomists.

The number of heterologous products has been variously stated by writers, but it admits of much doubt, I think, whether there are really more than four, namely, the tubercular, the scirrhous, the encephaloïd, and the melanotic. To these might, perhaps, be added the parasitic animals which are developed in different parts of the body, such as worms and hydatids, and the calcareous concretions which are found in certain cavities and canals, as in the urinary bladder, the ureters, the intestinal tube, and in the veins. Cirrhosis, sclerosis, and some other morbid appearances, comprised under the present head by Laennec and Beclard, are evidently foreign

to it, and must therefore be excluded. Any arrangement, however, that may be offered in the present state of the science must, from the very nature of the subject, be imperfect, and susceptible of further improvement. Indeed, I am not certain that the term heterologous, as applied to these formations, is not altogether ill-chosen and out of place, since most of them are found, when carefully investigated, to have a very close resemblance, in many of their most essential features, to the normal tissues of the body. Thus encephaloïd bears a striking similitude to the substance of the brain; melanosis, to the coloring matter of the skin; scirrus, to the dermoid texture; and tubercle, at least in some of its forms, to fibro-cartilage. But these are topics, concerning which, as we have no positive information, it would be idle to speculate.

Although the heterologous formations, properly so called, are not of equal frequency, yet they all have one common tendency, namely, to destroy, sooner or later, the structure in which they are located. Hence the propriety of the term malignant, under which some of them have long been noticed by authors, and from which arrangement, from some unaccountable circumstance, tubercle has hitherto been excluded. Not only, indeed, is this disease malignant, but, if we reflect upon the rapidity of its progress, and its extraordinary fatality, it must unquestionably be regarded, I think, as the most malignant of all the heteroclitic formations of which we have any knowledge. The period during which the morbid deposits remain, varies from a few months to several years,—a circumstance which, together with the several changes which they themselves undergo, and which they exert upon the structures in which they are located, will be again adverted to in the following sections.

These morbid products occur at all periods of life, in both sexes, and in nearly all the organs and tissues of the body. Their origin, although still enveloped in obscurity, is probably of an inflammatory nature, attended with an aberration of the nutritive function, and the deposition of a new substance unlike that, as we have already stated, in part or entirely, of any other in the animal organization.

SECTION I.

Tubercle.

OF all the heterologous formations, the most interesting, unquestionably, is the tubercular, whether it be viewed in reference to its frequency, the obscurity which still envelopes its nature, or the great attention which it has always elicited from the medical philosopher. Occurring at all periods of life, from the most tender infancy to the most decrepid old age, it is the cause, in all probability, of nearly one third* of all the deaths that annually happen throughout the world. If this be true, as the data which we have, though still very imperfect, would lead us to infer, it will be readily granted that a knowledge of the disease before us must be of vast importance to the practitioner, and worthy of his deepest study and investigation.

What is a tubercle? A correct answer to this question, it will at once be perceived, will be a matter of no little moment at the very outset of this branch of our subject. The term tubercle was anciently applied, in a very vague manner, to almost every kind of tumor, whatever might be its situation, form, consistence, or chemical composition. The confusion concerning the character of this and other morbid products, thus introduced in the infancy of the medical profession, prevailed during more than twenty centuries, and is still, there is reason to believe, sufficiently common amongst the physicians of our own times,—many of them being utterly incapable of pointing out the true distinction between tubercle, scirrhus, melanosis, and encephaloïd. The definitions which have been given of this term are almost as numerous as the authors who have written upon the disease. It is of Latin derivation, and literally implies a little swelling. In the sense in which I shall here use it, it denotes a small, solid tumor, of an irregularly spherical figure, more or less opaque, of a pale yellowish color, seldom exceeding the volume of a pea, susceptible of organization, and composed of a

* The greater part of this mortality is caused directly by pulmonary phthisis; the rest by tubercles of the lymphatic ganglions, the spleen, the serous membranes, and the bones.

peculiar serofulvous matter, which, sooner or later, undergoes a process of softening. Such, then, is the signification in which the term will be employed in the present section; though, as will appear hereafter, the definition does not embrace more than two of the varieties of form in which the tubercular matter is deposited; and it is rather in compliance with the established custom of pathological writers, than in reference to the rules of sound criticism, that I restrict the term within these narrow limits.

Tubercle, as before intimated, is an exceedingly frequent and destructive disease; and there is no organ in the body in which it has not occasionally been observed. I have seen it in the brain, lungs, thymus gland, pericardium, liver, spleen, kidney, supra-renal capsule, seminal vesicles and prostate gland, ovaries and uterus, the bones, intestinal canal, peritoneum, pleura, and arachnoid, the bronchial tubes, lymphatic ganglions, on the surface of adventitious membranes, and in the interior of a polypus of the nose.

The disease, however, is much more common in some organs and structures than in others. The lungs, lymphatic ganglions, the liver and spleen, together with the peritonæum, the intestinal canal, and the false membranes of the splanchnic cavities, are the parts, beyond doubt, in which tubercle is most frequently observed. Of these parts, the summits of the lungs and the lymphatic ganglions, especially those which are clustered around the bronchial tubes, are those in which the heterologous matter is most generally deposited; and it is important to remark, as has been justly observed by Professor Alison, of Edinburgh, that these are textures in which the capillary circulation must necessarily be very tardy. In reference to the primitive tissues, the cellular, it seems to me, is the one in which tubercle is most usually situated. The mucous element is, no doubt, also often the original seat of the morbid product, but by no means so frequently as is supposed by Professor Carswell.

It would appear, from the researches of some of the European pathologists, as Louis, Lombard, Andral, and Papavoine, that the *site* of tubercular disease is influenced, in a very considerable degree, by the age of the individual. This is a circumstance which, from its practical bearing, is deserving of further attention. The two following tables afford an account of the localization of this heterologous deposit in children and in adults. The first is constructed from the

excellent memoir of Dr. Lombard, of Geneva, and is founded on one hundred careful autopsic inspections made with a view of ascertaining the relative frequency of tubercles in different organs.

TABLE I.

Bronchial ganglions,	.	.	.	.	.	87 times.
Lungs,	.	.	.	.	.	73 "
Mesenteric ganglions,	.	.	.	.	.	31 "
Spleen,	.	.	.	.	.	25 "
Kidneys,	.	.	.	.	.	11 "
Intestines,	.	.	.	.	.	9 "
Nervous centres,	.	.	.	.	.	9 "
Cervical ganglions,	.	.	.	.	.	7 "
Cerebral envelopes,	.	.	.	.	.	6 "
Pancreas,	.	.	.	.	.	5 "
Gastro-hepatic ganglion,	.	.	.	.	.	5 "
Subperitoneal cellular tissue,	.	.	.	.	.	5 "
Inguinal ganglions,	.	.	.	.	.	3 "
Subpleural cellular substance,	.	.	.	.	.	2 "
Lumbar ganglions,	.	.	.	.	.	1 "
Urinary bladder,	.	.	.	.	.	1 "
Omentum,	.	.	.	.	.	1 "
Gall-bladder,	.	.	.	.	.	1 "
False membranes of the pleura,	.	.	.	.	.	1 "

The second table is compiled from the treatise of Dr. Louis, of Paris, and refers to persons that died of consumption after the age of fifteen. A comparison of this with the materials furnished by Dr. Lombard, will show the occurrence of tubercles in different organs in the two periods of life.

TABLE II.

Small intestines,	.	.	.	.	.	about $\frac{1}{3}$
Large bowels,	.	.	.	.	.	" $\frac{1}{9}$
Mesenteric ganglions,	.	.	.	.	.	" $\frac{1}{4}$
Cervical ganglions,	.	.	.	.	.	" $\frac{1}{10}$
Lumbar ganglions,	.	.	.	.	.	" $\frac{1}{12}$
Prostate gland,	.	.	.	.	.	" $\frac{1}{13}$
Spleen,	.	.	.	.	.	" $\frac{1}{14}$
Ovaries,	.	.	.	.	.	" $\frac{1}{20}$
Kidneys,	.	.	.	.	.	" $\frac{1}{40}$

In the one hundred and twenty-seven examinations made by Louis, the general results of which are exhibited in the

above table, tubercles occurred only once in the uterus, twice in the brain, once in the ureter, twice in the liver, and twice in the supra-renal capsules.

The inference deducible from these tables is, first, that, in children, tubercles not unfrequently occur in different parts of the body, without existing in the lungs; secondly, that they are more liable to affect the lymphatic ganglions than in adults; and, thirdly, that they have a tendency to attack a much greater number of organs simultaneously or successively. It is a singular circumstance, that the spleen is seldom tuberculized in adults, whilst it is very often affected in children, in the proportion nearly of one to four. It would appear, both from the observations of Louis and of Lombard, but particularly from those of the latter, that the liver is also remarkably exempt from the disease,—a result which is, however, strikingly at variance with the experience of Papavoine, who found these bodies in more than one fourth of his autopsies, namely, in fourteen children out of fifty. The intestines appear to be affected nearly equally in both periods of life.

The period of life most liable to tubercle is between twenty and forty. But no age is exempt from it, and, what is remarkable, it appears occasionally to exist as an intra-uterine malady. The late Professor Chaussier, of Paris, has related several cases of miliary tubercles in the lungs of the *fœtus*; and, more recently, several analogous examples have been published by Billard and Husson. In one of the cases, given by the latter of these writers, the infant was still-born at the seventh month; and the tubercles, which were seated in the pulmonary tissue, were in a state of softening. In the three examples mentioned by Billard, the disease occurred, in one, in the peritonæum, and, in the other two, in the mesenteric ganglions. My excellent friend and colleague, Professor Rives, a few years ago, met with tubercles in the lungs of an infant, six weeks old, some of which were concrete, others in a state of suppuration; and in a child of less than three months of age, which I examined last winter, similar phenomena were witnessed. On the whole, however, there is sufficient ground for concluding that tubercles are of comparatively rare occurrence in the *fœtus*, since, in many hundred dissections of new-born infants made in Paris, by Breschet, Guizot, and Velpau, these bodies were not seen in a single instance.

Of the great prevalence of tubercular disease in early life, little seems to have been known until a very recent period, and for our information concerning it we are mainly indebted to the researches of the Parisian anatomists. The facts which they have furnished upon this point are of a most startling nature, and the practical inferences to be deduced from them are too evident to require any comment in this place.

Tubercles are not peculiar to the human race. They have been observed in many species of animals,—in birds, reptiles, and even in insects; though, as respects the latter, facts are still wanting to illustrate the subject. Amongst quadrupeds they have been noticed in the ape and monkey, the horse, ox, elk, deer, and antelope, the dromedary, sheep, goat, hog, bear, lynx, dog, lion, tiger, cat, squirrel, and rabbit; amongst birds, in several species of macaws and parrots, the turkey, hen, sparrow, and flamingo; amongst reptiles, in the serpent, frog, and turtle.* In all these various classes of beings, the morbid deposit presents the closest analogy to that observed in the human subject, and is likewise more frequently seen in the lungs than in any other organ. Nor is it limited to any particular period of life. It is very frequently witnessed in the youngest animals, and Dupuy has even met with it in the *fœtus* of the sheep and rabbit. In lambs, from two to five months old, I have often seen the liver and lungs crowded with miliary tubercles.

It is a singular fact, and one not without its value in a practical point of view, that most of the wild and domesticated animals become affected with tubercles after a certain period of their confinement. Many of the quadrupeds that are imported into this country, and exhibited in our menageries, die from this cause; and the same thing is said to obtain in regard to the milch-cows in the larger cities of Europe. Here the disease is no doubt induced in the same manner and by the same agents as in the human subject,—inactivity, want of nutritious diet and of fresh air, being so many predisposing circumstances.

The composition of tubercular matter has been studied by several chemists, but the most recent and accurate analysis is by Dr. Hecht, a distinguished medical philosopher of Strasburgh. According to this indefatigable investigator, it consists of nearly equal proportions of albumen, fibrin, and

* Clark on Consumption and Scrofula, p. 212. London, 1838.

gelatine. With these results the examination of Thenard, previously made, is strikingly at variance. This individual found that one hundred parts of crude tubercular matter contained upwards of ninety-eight parts of albumen, the remainder being made up of muriate of soda, phosphate and carbonate of lime, and a minute quantity of the oxide of iron. These discrepancies in the results of these analyses may be accounted for, I think, by supposing that the chemical composition of tubercular matter varies, as no doubt it does, not only in the different stages of its existence, but also in different animals, and probably in different organs. In the ox, in particular, there is always a predominance of earthy salts, and hence the extraordinary bitterness which characterizes the morbid product in the animal in question. In the turtle I have seen the tubercular substance of the color and consistence of calcareous moss, or what, in mineralogical language, is termed tufa. The most interesting fact developed by the researches of Dr. Hecht, and to which I would especially direct the attention of the reader, is the existence of fibrin, which intimately assimilates this matter to, if it does not render it identical with, the adventitious membranes of the serous and mucous textures.

The morbid matter is deposited under several varieties of form. Of these the most common by far is that called the miliary, from its resemblance to a millet-seed, (Plate I, Fig. 1.) The tubercles in this species of the disease are of an irregularly spherical shape, and vary in size between a pin-head and a common pea. In the brain and liver they are sometimes as large as a cherry, a marble, or even a billiard-ball. Most generally they are of a dull yellowish color, occasionally grayish, and in many cases they are speckled, bluish, or of a pale milky aspect. Their consistence is also liable to much diversity. Sometimes they are as hard and dense as fibro-cartilage, whilst, at other times, they are soft, and almost semi-liquid. In the former case, they sensibly creak under the knife, and often exhibit, when cut, a bright vitreous appearance, not unlike ground glass. To tubercles possessing these properties Bayle and Laennec have applied the term "granulation," — an expression which is still retained by Louis, and some other writers.

In their primitive state, the miliary tubercles are perfectly distinct, but, ultimately, as they augment in volume and number, they coalesce, and thus destroy the separation, re-

sembling, in this respect, the pustules of confluent small-pox. In this way large masses are frequently formed, varying in density, from the consistence of recent lymph to that of cartilage, and presenting an ovoidal, globular, angular, or stellated configuration. Tumors of this description seldom exceed the dimensions of a walnut, yet sometimes they attain the bulk of an orange, the fist, or even of a foetal head. This variety of the tubercular deposition, although most common in the lungs, is often observed in the other organs, and in none more so, according to my own experience, than the spleen, peritonæum, liver, and kidney, the frequency of its occurrence being in the order here stated. It also occurs very often in the bones, especially in those of the spine, and in the lymphatic ganglions of the mesentery, loins, and bronchial tubes.

Cases occasionally occur, in which these bodies are surrounded by a distinct capsule, constituting the *encysted* tubercle of Bayle, (Pl. I, Fig. 2.) The envelope is usually of a fibrous nature, and of a pale grayish color; sometimes pink, violet, or mottled. Varying in thickness from the fourth of a line to a line, it adheres closely by its outer surface to the tissues into which it is deposited, and from which it can be separated only by the knife or by forcible detraction. The contents of the cyst are commonly of a grayish-yellow complexion, opaque, and speckled with dark points; and so long as they remain solid they are firmly attached to its inner surface. Both structures have probably a contemporaneous origin. This, however, is still a mooted question, concerning which it is impossible at present to come to any correct decision. In old tubercles the cyst is sometimes ossified, either in part, or wholly. Laennec mentions an example of this kind, and a similar one is described by the celebrated Bayle.

This variety of tubercle is very rare. Louis has seen only a solitary instance; and Professor Carswell appears altogether to doubt the possibility of its occurrence. The celebrated Laennec also met with it only on a few occasions; and, thus far, although I have made numerous examinations of persons who have died of this malady, I have never seen more than five or six well-marked examples of it. The situations in which it is most commonly found are the peritonæum, the lungs, the brain, the bronchial lymphatic ganglions, and the bones. According to Meckel, the encysted variety of tubercle

is more frequent in the inferior animals, as the monkey, dog, and antelope, than in the human subject.*

A third variety of tubercular matter exists in the form of *infiltration*, (Pl. I, Fig. 3.) It is often found around tubercular excavations, sometimes in considerable patches, of a grayish or yellowish appearance, more or less dense, crisp, and firm, like cartilage. In its texture it is apparently homogeneous, presenting, when divided with the knife, a smooth, polished surface, in which it is impossible to discern the slightest trace of the original structure. Occasionally the deposition has the aspect and consistence of jelly, constituting the *gelatinoid infiltration* of Laennec, — a distinction which is as unscientific as it is unnecessary, since it forms merely a variety of what I have just described.

The fourth and last variety is the *stratiform*, in which, as the name imports, the tubercular matter is deposited in the form of a layer, generally upon the free surface of the mucous membranes, (Pl. I, Fig. 4.) Next to the miliary variety, this seems to be the most common form in which this substance is secreted. It is very frequently met with in the bronchial tubes, and occasionally, though much more rarely, in the ureter and pelvis of the kidney, the uterus, and the seminal vesicles. This variety of tubercle is not peculiar to the human subject. It has been repeatedly observed in the cow, sheep, and rabbit ; and I have myself recently seen a beautiful specimen of it in the lungs of the green turtle, which I have placed in the museum of the Cincinnati College. The tubercular matter, in this case, is deposited, in some places, in thin, yellowish patches, of an irregular shape, and from the diameter of a five-cent piece to several inches ; in others, in long, cylindrical masses, which are accurately moulded to the tubes in which they are situated. In some of the bronchiæ, the secretion is firm and tenacious, being with difficulty separated from the mucous surface ; in others, it is very brittle, dry, and apparently unconnected. Many of the air-vesicles are entirely closed up with this substance, and, what is remarkable, it seems to contain a much greater amount of earthy matter here than where it is spread over the bronchiæ.

When the tubercular matter is poured into the seminal vesicles, the uterus, the ureter, or pelvis of the kidney, the

* Pathol. Anatomie, 2 ter Band. S. 370.

stratiform arrangement is only well-marked so long as the deposit is scanty ; for, as soon as it becomes abundant, it assumes an amorphous, nodulated form, composing masses which occasionally entirely distend the interior of these reservoirs. The same arrangement is often witnessed in the bronchial tubes, and, from the matter sometimes reaching from them into the air-cells, it is not unusual to see it form small cauliflower-shaped expansions.

Such, then, are the four varieties of form in which the tubercular matter is deposited in our organs and tissues, namely, the miliary, encysted, infiltrated, and lamellated. Of these, the first and last, it will be recollect, are the most common, not only in man, but also, so far at least as we now know, in the inferior animals ; and they are all, it is obvious, entirely dependent on the structure of the part in which they occur. The *consistence* of the tubercular matter also varies, it should be remembered, from that of a fluid to the firmness of cheese, fibro-cartilage, cartilage, and even bone.

Much has been said by writers respecting crude and semi-concrete tubercles, some supposing that they are originally deposited in a solid, others in a liquid state. Without stopping to inquire into the merits or demerits of these questions, which the limits of this paper will not admit, it may be remarked that every known fact in pathological physiology is strongly corroborative of the opinion, that all tubercular matter is primitively soft, semi-liquid, or gelatinous. The chemical, physical, and anatomical characters of this matter, all conspire to show its similarity with the coagulating lymph, as it is revealed to us upon the free surface of the serous and mucous textures, in the various splanchnic cavities, upon the surface of a recent wound or a granulating ulcer, and finally upon the surface of the crassamentum of blood taken from persons affected with inflammation. From the well-conducted researches of Dowler, Gendrin, and Bretonneau, it clearly appears that the substances found in these different situations are all composed essentially of albumen, fibrin and gelatine, in varying proportions, there being sometimes a predominance of the one, sometimes of the other. The similarity, then, of these morbid products being admitted, as unquestionably it must, who will contend that the tubercular matter is ever deposited in the solid form ? Where is there an instance in which the fibrin of the blood is eliminated in a concrete state ? Do we find it thus poured out in the inflammations

of the serous membranes? Is it thus deposited upon the interior of the larynx, the trachea, and bronchial tubes, the interior of the uterus, or the alimentary canal, between the edges of a recent wound, or around the fragments of a broken bone? Experience and common sense alike answer in the negative. But this is not all. In certain parts of the body, as, for example, in the peritonæum, we can detect nature, as it were, in the very act of her work, and distinctly examine this substance as it is about being converted from the fluid into the solid state. In several cases of chronic inflammation of this membrane, I have discovered tubercles in every possible stage of developement, some of them — evidently deposited only a day or two before the individuals expired — being of a soft, viscid consistence, and perfectly transparent appearance; others semi-concrete, yellowish, and consequently more or less opaque; and, lastly, another set perfectly dense and firm, like fibro-cartilage, organized, and covered by an accidental serous membrane, of the most delicate texture. Thus, the conclusion is obvious, that all tubercular matter, whatever may be its form, site, extent, is, in the first instance, of a liquid nature, and that it becomes solid only by the removal of the serosity which is always poured out simultaneously with it.

The period required for the developement of solid tubercles is so exceedingly variable that it is difficult, if not impossible, to lay down any definite rules on the subject. In acute phthisis, Louis says that they may reach the size of a pea in three or four weeks; and, in the peritonæum, there is reason to believe that they often attain this bulk in a much shorter time, though this is a point which has not yet been satisfactorily settled. In other cases, they remain small for a considerable period, sometimes for several months, and perhaps even years; all the symptoms of the disease being, in the mean time, fully formed.

Various notions have been entertained by pathologists respecting the precise nature of tubercles, some of which, it must be confessed, are extremely crude and unsatisfactory. Hippocrates and Aretæus, Fernal and Morgagni, ascribe their formation to the concretion of a thick, viscid fluid, poured out by the vessels into the delicate texture of the lungs, and probably analogous to what has since been termed the coagulating lymph. Sylvius de la Boe, whose works were published towards the close of the seventeenth century, imag-

ined that they were nothing but lymphatic ganglions, which, scattered every where through the parenchymatous structure of our organs, were rendered morbid by the effects of inflammation. This opinion was afterwards adopted, and more fully illustrated by Wepfer and Morton, and, strange as it may seem, it has received the sanction of the great Broussais, and several other distinguished authors of our own day. Our illustrious countryman, Dr. Rush, considered tubercles as a collection of inorganic mucus ; and Laennec, it is well known, believed that they are always deposited in a crude state. The reverse of this view has been recently maintained, with much zeal and pertinacity, by Dr. Baron, an eminent English physician. In his "Inquiry on the Nature of Tubercular Accretions," published in 1819, he attempts to prove that these little bodies are essentially hydatic, and that, instead of passing from an indurated to a softened state, as is asserted by Laennec and some of his disciples, they are originally simple vesicles, filled with thin, albuminous matter, which, in process of time, undergoes inspissation.* Amidst such contrarieties of opinion, it is extremely difficult to decide which of the hypotheses here referred to is most entitled to our confidence and regard. After much reflection, however, upon the subject, and from careful and repeated examinations of tubercles in different organs of the body, in different individuals, and in different stages of their developement and growth, I am constrained to believe that the heterologous formations are originally nothing but a species of coagulating lymph, thrown out as an effect of inflammatory irritation, and modified in its character according to the tissues in which it is deposited.

The doctrine of the hydatic origin of tubercles, although highly ingenious, and ably defended by its author, is, besides

* "It is probable that all tubercles, wherever situated, and of whatever substance composed, were, at their commencement, small vesicular bodies with fluid contents. It is impossible to say how minute they may have been at their origin, nor how large they may grow before their transformations begin ; nor are we acquainted with the circumstances which occasion such transformations. But that they do take place has, I conceive, been demonstrated beyond the possibility of doubt." (Baron's Inquiry illustrating the Nature of Tubercular Accretions of Serous Membranes, p. 214. London : 1819.) Further on, the same author remarks : "It is not known how the change in hydatids are effected; but to these changes, certain tubercles owe their existence, and on the size, relative position and structure of the tubercles which are so formed, depend the characters of many of the most formidable disorganizations to which the human body is exposed." (Ib. p. 215.)

being opposed by analogy, wholly unsustained by facts. Dr. Dupuy, a distinguished veterinary surgeon of Paris, has frequently witnessed, it is true, the coexistence of tubercles and hydatids in the lungs and other organs of the inferior animals ; but such an occurrence, it is well known, is extremely rare in the human subject ; nor, were it more common, would it at all prove that the former of these bodies owed their origin to the latter, any more than that carcinoma and melanosis, because they are sometimes found together, are dependent the one upon the other for its evolution and subsequent growth : it merely shows that these morbid products may occur in the same organ ; certainly nothing more. On this point two of the best authorities of the present day, Andral and Louis, perfectly agree. Both these writers have had ample opportunities for testing the truth of Dr. Baron's doctrine ; yet what is their conclusion ? Why, that it is entirely erroneous, from beginning to end. In many thousand dissections, they declare that they have never seen hydatids in more than five cases, and in only one of these was the disease complicated with tubercles. My own experience, although much more limited, is of a similar character ; as is also that of Dr. Stokes, of Dublin, decidedly one of the most intelligent observers of the present day. But independently of the great infrequency of hydatids in our organs and tissues, the fact that the tubercular matter is deposited upon the free surface of the mucous membranes, and infiltrated into the cellular element in various situations, is at once a death-blow to the doctrine, I should rather say hypothesis, which we have been considering.

Believing, then, that the doctrine of the entozoic origin of tubercles is fundamentally untrue, unsupported, as it is, either by observation or analogy, I will merely remark, in concluding this branch of the subject, that we are not singular in ascribing the formation of these bodies to inflammatory irritation. Broussais, as has been already intimated, adopting the views of Wepfer and Morton, is one of the most strenuous advocates of this opinion ; though he undoubtedly erred, in common with these writers, in supposing that tubercles are merely diseased lymphatic ganglions. This hypothesis, indeed, is at once overthrown by the well-known fact, that strumous matter is frequently found upon the free surface of the serous and mucous membranes, where there is an entire absence of absorbent glands. Still more conclusive evidence

is afforded by the presence of tubercles in the substance of the adventitious textures, in the thoracic and abdominal cavities. The inflammatory origin of these deposits is also maintained by Andral, Lombard, Alison, Ravire, Roche, and Sanson. Louis, on the contrary, supposes that irritation, although it may occasionally exert an influence of this kind, produces no such results in the great majority of cases. Dr. Stokes, again, refers the tubercular matter to a lesion of nutrition, generally brought about by local excitation. The views of this eminent physician do not therefore differ much, if at all, from those of the above pathologists.

In summing up the pathology of this deposit, Andral remarks that "it must be considered as the result of a modification or perversion of secretion, which is often attended or preceded by an active sanguineous congestion. This is all we know for certain; beyond this, every thing is mere conjecture."

The doctrine, moreover, of the inflammatory origin of the deposition in question, derives great plausibility from what is observed to occur in the inferior animals from mechanical irritation. In the experiments of Cruveilhier, Kay, and Saunders, well-characterized tubercles were produced in a very short time, simply by dropping mercury into the trachea, and keeping it in contact with the minute vessels of the lungs. When we couple the result of such investigations with what is witnessed in persons who habitually inhale irritating particles of matter, such as weavers, needle-grinders, and miners, who are peculiarly liable to pulmonary phthisis, and with the circumstance that incipient tubercles frequently coexist with capillary engorgement, serous effusion, and deposits of lymph, the conclusion forces itself irresistibly upon the mind, that these bodies are produced by inflammation, either of an acute, or, as is perhaps more frequently the case, of a slow chronic character.

Laennec supposes that tubercles grow by intussusception, that is to say, from without inwards. This view, however, has been shown to be erroneous, it being well known now that particle after particle is deposited around the original nucleus of matter, until the foreign body attains its full developement. The process is thus not unlike that of amorphous crystallization.

Are tubercles ever organized? On this subject, too, much diversity of sentiment prevails amongst pathological anato-

mists. By most of them, indeed, the question is but faintly alluded to, and, so far as my information extends, there is not a single one who has furnished us with any satisfactory account of it. "The most important fact," says Professor Carswell, "connected with these bodies is, that they are not susceptible of organization, and consequently give rise to a morbid compound, capable of undergoing no change that is not induced in them by the influence of external agents." "Whatever," remarks Dr. Clark, in his Treatise on Pulmonary Consumption, "may be the site, consistence, or form of tubercular matter, it is to be regarded as a morbid inorganizable product, and consequently insusceptible of any change that is not affected by the living tissue in which it is deposited." In speaking on this subject, Professor Alison, of Edinburgh holds the following language: "Although tubercles undergo various changes in the interior of their substance, at various periods after their deposition commences, it does not appear, from injections, that they are themselves provided with vessels, and hence they have been called morbid secretions, perhaps more properly than adventitious textures." Such are the sentiments of three of the most distinguished pathologists of Great Britain. How far they are correct, we shall endeavor to show, as we proceed with the discussion of this question.

That tubercles are invariably organized, that is, provided with vessels, nerves, and absorbents, no one, at all acquainted with the subject, will, it is presumed, attempt to assert. There are some situations, indeed, in which it would be impossible for the process to be effected; as, for example, when the strumous matter is spread over the free surface of the mucous membranes, whether in the bronchial tubes, the uteris, seminal vesicles, or the excretory ducts of the kidneys. Here the heterologous nature of the contents of these reservoirs would be alone an insurmountable barrier to the organization, to say nothing of the peculiar modified character of the morbid secretion itself. I say *peculiar modified character*, because it is well known that the chemical and physical properties of the tubercular deposits are widely different in the localities here specified from what they are in other parts of the body. They are usually of a deeper yellowish color, and much more curdy and friable, from their containing a much greater amount of earthy ingredients. Upon this point, it is impossible, I conceive, that there should be two opinions.

Thus, then, it may be stated, as a general proposition, that, when the tubercular matter is deposited upon the larger mucous surfaces, it is not susceptible of organization ; whilst, when it is effused into the cavities of the cellular tissue, into the air-vesicles of the lungs, and into the intermolecular spaces of our organs, it may, and often does, become “ part and parcel ” of the living frame. Within the last two years, I have examined not less than six specimens of organized tubercles, one occurring in the kidney, two in the spleen, one in the peritonæum, and two in the lungs. They were taken mostly from children under twelve months of age. The tubercles were of the miliary kind, and numerous vessels, loaded with florid blood, could be seen shooting into them in every possible direction, many of them penetrating a considerable distance into their substance. Their vascular supply would thus seem to be derived from the tissues in which they are deposited ; and this, in the generality of cases, is no doubt true ; nevertheless, there is reason to suppose that they occasionally possess a self-organizing power, analogous to that of the adventitious membranes in the splanchnic cavities. Placed under favorable circumstances, coagulating lymph can always create vessels of its own, as is shown in the formation of the placenta, and of what are termed the analogous tissues ; and, although the vessels thus constructed are very small and few in number, they are sufficient, it is presumable, in many instances, to preserve the vitality of the tubercle without the aid of the circumjacent textures. Generally, however, such aid is not long withheld ; for as the newly-formed vessels extend from the central to the peripheral portion of the heterologous deposit, they speedily communicate with arteries and veins belonging to the affected organ. It is in this manner that the vitalization of tubercles may be supposed to be effected, and in proportion to its perfection will be their power of resisting such agents as have a tendency to destroy them.

In making these remarks, I would not wish to be understood as asserting that I have seen the vessels which have been supposed here as forming the proper circulation of tubercle : their existence is altogether assumed from the analogy afforded by encephaloïd growths, and the adventitious membranes. Actual observation will, perhaps, never avail us greatly in determining the question, inasmuch as the subject is beset with difficulties scarcely to be found in any other morbid deposit. But I do assert, unhesitatingly, that I have repeat-

edly traced vessels into such tumors from the tissues around them, and, that upon dividing them, the section thus made has frequently exhibited small florid dots of blood. Several of these examinations were made in the presence of highly intelligent pupils, and one was witnessed by Professor Harrison, my distinguished colleague in the chair of *materia medica*. But it may be objected that these vessels have never been injected. Granting this to be true, and what, it may be asked, does it prove? Are we reduced to the necessity of denying the vitality of a structure, because we cannot succeed in throwing foreign substances into its vessels? If this be a fair criterion, then we must conclude that the cornea, the crystalline lens, the membrane of Jacob, the inner coat of the arteries and veins, the endocardium, and the arachnoïd tunic of the brain, together with the chorion and amnion, are not organized. But who would be so silly as to suppose that this was the case, when daily observation demonstrates that these textures are abundantly supplied with vessels, nerves, and absorbents, though none of these tissues can be detected by inspection, no matter to what methods we resort to for that purpose.

At what period the organization of tubercles commences, is a point concerning which we are still perfectly in the dark, and which must remain for the present undetermined. It is reasonable, however, to suppose that nature observes no uniform law in regard to this matter, and that she begins her efforts at vitalization at a period varying from two to three days to as many months, from the moment of the morbid deposition.

I have never been able to trace any nerves or absorbent vessels into these bodies, nor am I aware that this has been done by others; nevertheless, as these structures are every where necessary to organization, it is allowable at least to infer their existence. Another proof, but of a more indirect character, of the organic nature of tubercle, is furnished by the fact, witnessed by numerous and highly respectable observers, that these bodies are often of a yellowish tint in jaundice,—owing obviously to the admixture of the coloring matter of the bile with the blood, both being simultaneously circulated through the heteroclite mass.

But, whatever notions may be entertained concerning the origin and nature of these bodies,—whether we consider them with Wepfer, Broussais, and others, merely as diseased

lymphatic ganglions, or with myself, as depositions of coagulating lymph, produced by inflammatory action, and susceptible, under certain circumstances and conditions of the system, of organization, they sooner or later become soft and fluid, the necessary consequence, it may be presumed, of their crude state. This process is supposed, by Louis and Laennec, always to begin in the centre of each mass; but Andral and Carswell maintain that it may commence at any part, indifferently, at the centre or at the circumference; and such, precisely, is the result of my own observations. As it progresses, the tubercular matter becomes daily more and more soft, moist, and unctuous, until at length it acquires the ropiness and fluidity of pus. When the degeneration involves the whole mass, it is usual to find two different kinds of matter in it; one thick, straw-colored, and inodorous, like laudable pus; the other thin, commonly tinged with blood, and mixed with small, opaque, cheesy flakes. This is more particularly the case in scrofulous subjects, in whom the fluid in question often strongly resembles whey, with minute portions of curd floating in it.

Conformably with the doctrine which it has been attempted here to enforce,—that tubercles are organized structures,—the process of softening may be supposed to be analogous to slow suppuration, by which the heterologous tissue is gradually broken up and destroyed. Let me be understood. After tubercles have existed for some time in an organ, as, for example, the lungs, they begin to act as extraneous bodies, producing irritation in the immediately circumjacent textures. This irritation, it may be presumed, is speedily propagated to the tubercles themselves; and, as their vital endowments are comparatively feeble, and consequently incapable of much resistance, they soon yield to the invasion, the rapidity of their softening being always in direct proportion to the violence of the exciting cause and the density of the morbid growth. Those, on the other hand, who believe that tubercles are inorganic, maintain that their softening is brought about by the agency of the surrounding tissues, alleging that they are incapable of undergoing such a change by any powers of their own. If this explanation were correct, the process should always begin at the periphery of these bodies, which, however, as was before stated, is not the case.

The softening takes place much more rapidly in some organs than in others, in which it does either not occur at all,

or only after a long period. In the lungs, where the process has hitherto been chiefly studied, it may take place as early as the end of the first month from the time of the deposition, though generally not until much later. Upon this subject, however, it is obviously impossible to lay down any definite rule, as the production of the phenomenon in question must necessarily be influenced by a great variety of causes, such as the extent of the disease, the state of the patient's health, the density of the heterologous deposit, together with numerous other circumstances which will readily suggest themselves to the mind of the reader. Occasionally the softening goes on simultaneously over a large extent of surface, so as to break down one third, a half, or two thirds of an organ; but this occurrence is extremely rare, and is confined exclusively to acute cases. In the lungs, the degeneration usually begins at the summit of these organs, and gradually extends towards the base, as is shown by the fact, that if these viscera be examined in this direction, we successively find, at various heights, excavations and tubercles in different stages of softening,—the more solid being almost always lowest in the scale. Before the changes, of which we have now spoken, take place, the morbid deposit appears to create little disturbance in the general economy, and may exist, sometimes to a very considerable extent, without giving rise to symptoms indicative of its presence.

After having become perfectly soft, the tubercular matter is either absorbed, or, if it be favorably situated, it works its way out. In the lungs, it usually breaks into the bronchial tubes, leaving thus, not unfrequently, a considerable number of *excavations*, or *fistulous apertures*. In the examinations of Dr. Louis, these caverns were never found entirely empty before the end of the third or the beginning of the fourth month, counting from the time of the invasion of the disease. In recent cases of this kind, the walls of the chamber are soft, and lined by a thin coating of lymph: in more ancient ones, the false membrane is dense, grayish, sometimes semi-cartilaginous, and from one fourth to one third of a line thick.

These excavations are most common in the lungs: they are sometimes found in the brain, the liver, spleen, kidney, and bones; but so seldom, that our knowledge concerning them is still very imperfect. In the kidney I have met with this lesion but once, in a young man, whose case will be

more particularly described in its proper place. In the long bones, these caverns, as they may be termed, occasionally communicate with the medullary canals, or some contiguous joint, establishing thus an analogy with tubercles of the lungs opening into the bronchial tubes ; and in the short bones, as those of the spine, it is not uncommon for them to work their way out to the surface, in many instances by long, tortuous passages, which it is always difficult, nay, frequently impossible, to heal.

The size of these caverns is sometimes very considerable. I have frequently found them as large as a hen's egg, and, in one or two instances, even of the volume of the fist : generally, however, they are much smaller, not exceeding the size of a hazelnut, an almond, or a walnut. The lesions which have been observed in the pulmonary tissue around these cavities, together with the changes experienced by the vessels, will be more fully described in the chapter on tubercles of the lungs, to which we must also refer for an account of the process of cicatrization, as it takes place much oftener in those organs than in any other parts of the body.

SECTION II.

Melanosis.

ONE of the most singular, and, at the same time, one of the rarest of the heterologous formations, is the melanotic, — for a correct knowledge of which, we are indebted to Laennec. The first account of this disease was given by this distinguished pathologist in 1806, in the *Bulletins de la Faculté de Medicine de Paris* ; and the same description was afterwards embodied in his learned work on thoracic maladies. The term employed to designate this morbid product is a Greek compound, literally signifying the black disease, and is synonymous with what Dupuytren and Alibert, with some others, have since called black cancer.

The account which Laennec has left of this accidental product, and which may be considered as one of the most accurate and graphic that has ever been furnished, describes it as

a homogeneous substance, very similar in its structure and consistence to a bronchial gland, of a deep black color, opaque, humid, and slightly inctuous to the touch. This substance, after a while, has a tendency to become soft, — the process by which this is effected generally commencing in the centre, and gradually proceeding towards the circumference, until it is entirely broken up and dissolved. When this is accomplished, nature sets up an eliminating effort, the surrounding parts take on inflammation, and the heterologous matter is finally expelled, thus leaving a corresponding cavity, which either continues open, is lined with lymph, or else completely obliterated.

No age nor sex seems to be exempt from this disease, though it is, without doubt, much more frequent in the old than in the young. Nor is it confined exclusively to the human subject. Dupuy and Rodet have frequently seen it in the horse; Breschet and others, in the dog, cat, rabbit, rat, and mouse; and I myself often in the ox. What is remarkable, this substance is much more common in white than in colored horses; and the same is true, I have reason to believe, in regard to cattle. To what this circumstance is to be attributed, it is not very easy to determine, unless we admit the conjecture of Andral, that the black pigment of the skin, instead of being deposited in its usual place, is transferred to other organs and textures in which it is not naturally found. In the horse, melanosis most frequently occurs under the shoulder-blade, in the pelvis, around the anus and vulva, and along the under surface of the tail. It is also frequently observed beneath the skin, where it forms numerous chaplets, composed of granular bodies, from the size of a filbert to that of a small egg.

The melanotic substance has been examined by different chemists, both in England and on the continent of Europe; and, although the results are somewhat varied, yet they all agree in one important particular, which is, that it bears a very strong analogy in its composition to that of blood. My limits will not allow me to enter into any minute details concerning this subject, and I shall therefore merely observe, that the most complete investigation which has been made, is that of Dr. Barruel, of Paris. According to this distinguished chemist, melanosis of the human subject is essentially composed of the coloring matter of the blood, united with fibrin, and of three distinct fatty substances. Of these, the

first is soluble in alcohol at a moderate heat, and susceptible of crystallizing in small brilliant scales; the second, is soluble only in boiling alcohol,—soft, and amorphous; the third is fluid at the ordinary temperature of the atmosphere, of a reddish brown color, and contains a considerable quantity of the phosphate of lime and iron. The result of this analysis is fully confirmed by that subsequently obtained by Dr. Hecht, of Strasburgh, from a specimen of melanosis of the lungs; and it corroborates, likewise, its identity with the coloring matter of the blood.*

Dr. Henry, of Manchester, found that a stream of chlorine, passed through a solution of this substance, destroys its black color, and throws down light yellowish flakes. Boiling produces no change, not even when a small quantity of caustic potash is added. Acids do not alter it, except the nitric, which turns it yellow. Corrosive sublimate, the nitrate of mercury, and the muriate of tin, precipitate it, the supernatant fluid being left quite clear.

To these analyses it may not be improper to add the results recently obtained by Dr. Foy, of Paris, from a melanotic tumor of the horse. They are as follows:

Albumen,	15.00
Fibrin,	6.25
A highly carbonized principle, probably altered cruor,	31.40
Water,	18.75
Oxide of iron,	1.75
Sub-phosphate of lime,	8.75
Muriate of potash,	5.00
" " soda,	3.75
Carbonate of soda,	2.50
" " lime,	3.75
" " magnesia,	1.75
Tartrate of soda,	1.75
	100.40

The melanotic matter is miscible with water and alcohol, opaque, and without any marked taste or smell. When placed in contact with white linen, it readily communicates to it its peculiar tint; but the stain that is thus produced is easily removed by ablution. Exposed to the atmosphere, it becomes

* Lobstein, vol. i. p. 463.

dry, brittle, and pulverizable, and a long period elapses before it undergoes decomposition. By burning, it is converted into a dark carbonaceous substance, and emits a strong empyreumatic odor.

The color of melanosis, as might be expected, is considerably influenced by accidental circumstances, as the quantity of crux and cellular tissue entering into its composition. It may be said always to incline to black; but not unfrequently it presents various shades of brown and yellow, which are usually most conspicuous when this substance is stirred in a small quantity of water. In its consistence, melanosis varies from the fluidity of ink to the density of fibro-cartilage.

With respect to form, there are three varieties under which this matter is deposited, the tuberoid, lamellated, and dot-like. The first of these, as the name indicates, occurs in distinct masses, varying in diameter between a currant and a walnut, of a dull sooty color, and of a spherical, ovoidal, or conical shape, (Pl. II, Fig. 1.) By the agglomeration of a number of such bodies, large tumors are sometimes formed, with a rough, lobulated surface, which always attain their greatest developement in the cellular and adipous tissues. In the human subject, their size seldom exceeds that of the fist; in the horse, on the contrary, they have been found to weigh from twenty to forty pounds.

A thin, transparent covering, evidently formed out of the natural tissues, invests these tumors, and gives them the appearance as if they were encysted. Vessels and nerves can occasionally be seen ramifying over their surface, or penetrating into their substance, and in many cases they are intersected by fibrous filaments, which are either derived from the general envelope, or they are the remains of the lacerated cellular substance into which the heterologous matter is originally deposited. These circumstances have led to the opinion — at first sight plausible enough, yet wholly erroneous — that these tumors are organized. Of the vessels which are distributed to the melanotic mass, the veins greatly predominate: they are often very large and tortuous, and Noack says that they terminate by open mouths on the interior of the cysts. Both arteries and veins are incapable of being injected, the matter that is used for this purpose being always extravasated in the substance of the morbid deposit.

When the tumor is developed on the serous surfaces, it frequently presents a pedunculated appearance, like certain polypi

of the uterus and the vagina, (Pl. II, Fig. 2.) In such cases it is always surrounded by a distinct cyst, of which it is difficult to say whether it be a new formation, or simply an extension of the natural membrane. There is another variety of melanotic tumor in which the covering seems to be formed by condensed fibrin, effused, in all probability, in consequence of the irritation excited by the presence of the foreign matter. Sometimes the cyst is of considerable thickness, firmly connected with the circumjacent tissues, and furnished with minute vessels; generally, however, it is remarkably thin, soft, flocculent, and without the least visible trace of organization. This variety of melanosis occurs most commonly in the liver and the brain. It is extremely rare. Carswell states that he has never seen an instance of it, and Laennec appears to have met with it only twice. I have noticed it several times in the liver of the ox.

The lamellated variety has hitherto been observed chiefly in the inferior animals, being extremely rare in the human subject, (Pl. II, Fig. 3.) It is confined exclusively to the serous membranes, where it is usually deposited into the connecting cellular tissue, forming small, irregular patches, of a black brownish color. More rarely the matter is poured out upon the free surface of these textures. When this happens, the layer is seldom more than half a line in thickness, of a soft, pulpy consistence, and covered over with a thin transparent pellicle of new formation. The peritonæum is the most usual seat of the lamellated variety of melanosis; and here it is often extremely difficult to distinguish it from the spurious form of the disease, caused by the deposition of blood, and the subsequent changes which this fluid undergoes from contact with the acid contents of the alimentary tube. In some instances the serous membranes present a stained appearance, as if the heterologous matter had been effused into their intermolecular spaces. Such spots are very frequent in the peritonæum of those who die of ascetes.

In the dot-like variety, (Pl. II, Fig. 4,) the melanotic matter appears in small points, thousands of which are sometimes scattered over the surface of the affected organ, giving it a singularly speckled aspect. This form of the disease, which may be easily imitated by dusting a piece of white paper with soot or powdered charcoal, is most common in the lungs, the liver, and the subserous cellular tissue of the alimentary tube. I have also repeatedly seen it in the skin of white

horses. When the points are very close, the affected part may present the appearance of being infiltrated, as in Plate II, Fig. 5.

The tissues most prone to the melanotic deposition are, beyond all comparison, the cellular and adipous. Amongst the different organs, the liver, lungs, and ovaries may be enumerated as being most frequently affected. The cartilages, synovial membranes, and fibrous textures, are rarely if ever implicated. Occasionally the system seems to be really laboring under a sort of melanotic diathesis, the disease occurring either simultaneously, or in rapid succession, in a great number of organs and tissues. Of this, a remarkable case has been recently published by Dr. Norris, an English physician.* Not only was the external surface extensively studded with black tumors, but immense numbers were seen scattered over the stomach, intestines, mesentery, and omentum; the lymphatic ganglions, kidneys, pancreas, and liver, were also more or less affected; the lungs were thickly mottled throughout the greater part of their texture; and the heart was literally encrusted with them, both externally and internally. The brain was healthy, but the dura mater was deeply involved. In the interesting case recorded by Professor Alison, of Edinburgh, the integuments, mammae, ovaries, membranes of the brain, heart, lungs, pleura and peritonæum, the sternum and ribs, together with a large portion of the parietal and occipital bones, were all affected with this disease; some of them in a very high degree. Like tubercles, then, this heterologous deposit seldom occurs in a single organ, but generally in a considerable number of them, which corroborates our assertion, that the system occasionally labors under a melanotic diathesis.

Melanosis may exist alone, or be combined with other heterologous formations. Of these, the most common is the scirrhous; the rarest, the tubercular. Dr. Rouzet met with a case of carcinoma of the breast, in which a black fluid, evidently of the nature of that in question, constantly exuded from the ulcerated surface. The tissues immediately around the melanotic deposit are often very much contaminated. Sometimes they are only hardened, or perhaps softened; at other times they are extensively infiltrated with the morbid matter, and of a deep black color. When the tumors are

* Medico-Chirurgical Review, October, 1836.

developed in the muscular substance, the fibres are merely pushed aside by them, without being contaminated by the disease. The nerves and bones likewise remain intact.

Melanotic tumors, after having acquired a certain size, generally remain stationary, giving rise to little or no inconvenience, save what results from their bulk and consequent pressure. At times, however, they manifest a disposition to ulcerate, and, when this happens, a most intractable sore is left, with hard, ragged edges, from the surface of which there is a constant discharge of black, inky matter, mixed with blood, pus, or a thin, fetid, ichorous fluid, formed by the surrounding structures. When removed, the most remarkable feature of these tumors is their tendency to reappear in the neighborhood of the cicatrix, or in some remote organ.

Notwithstanding that Laennec has asserted the contrary, the melanotic matter is probably always poured out in the liquid form. Indeed, we can scarcely conceive of the possibility of its being secreted in any other way. In the course of a short time after the deposition has taken place, the matter becomes inspissated, by the gradual absorption of its more attenuated particles; and it is in this manner that it finally acquires the hardness and density of a solid substance. What corroborates this view, is the fact, that thin, liquid melanotic matter is sometimes found in the splanchnic cavities without any breach of the serous membranes, and that it frequently exudes in this form from the surface of carcinomatous and other tumors, in a state of ulceration.

Of the causes of this disease, and of the states of the system which predispose to it, nothing can be said to be known with any degree of certainty. That the melanotic matter is derived immediately from the blood, both anatomical examination and chemical analysis abundantly show; but how far, or in what respect, this fluid is altered before the deposition in question is effected, are points in the history of this disease concerning which pathology and physiology are equally silent and undetermined. If we remember that melanosis is essentially composed of the same elements as the coloring matter of the skin and of the choroid coat of the eye, it may be allowed us to suppose that this substance, existing in an unnatural quantity in the blood, is deposited into organs and tissues in which it does not exist in the normal state, by an aberration of the nutritive functions of the vessels. Noack, a recent

German writer, regards the black matter as a secretion from the veins,—an opinion in which he is joined by Dr. Hodgkin, of England. This view, I need scarcely remark, is altogether gratuitous, and is, moreover, entirely inadmissible on physiological grounds, there being no instance, so far as we know, except in the liver, in which the veins perform such an office. This disease, I presume, is extremely rare in the inhabitants of this country. It is said to be most common in individuals who are of a melancholic temperament, and occasionally betrays a hereditary tendency.

SECTION III.

Scirrhous.

CONCERNING no one of the heterologous formations have anatomists expressed such a diversity of sentiment as of that, the nature of which we are about to investigate. Notwithstanding the numerous treatises that have been published within the last thirty years, it is a singular fact that we are scarcely in possession, even at the present moment, of an accurate and unexceptionable definition of the term scirrhous. The reason of this may be discovered, if I mistake not, in the circumstance that all malignant diseases, whatever be their origin, seat, or structure, were described, until very recently, under the vague name of "cancer." Nor was this the only difficulty. Scirrhous, as will be shown hereafter, often co-exists with encephaloïd, which, independently of the varieties to which it is itself subject, must have been a source of much confusion and embarrassment. No wonder, then, that writers should have failed in presenting clear and definite notions on the subject. Indeed, with all the light that has been thrown upon the heterologous formations by morbid anatomy, it must be confessed that the most experienced find it sometimes extremely difficult, even at the present day, to draw a correct line of demarcation between scirrhous and encephaloïd.

How far the definition which we are about to give is free from objection, must be left to others to determine. Those who are acquainted with the difficulty of the subject will

agree with me at least, that any effort of the kind, although it may only be approximately correct, is much better than none. No lesion can be studied with advantage, unless the student have a proper notion of its nature at the very outset of his examination ; and nowhere is this more true than in the disease before us. With these remarks, I proceed to define scirrhous to be a hard, crisp, opaque substance, of a light grayish color, with dull yellowish fibrous intersections, organized, liable to lancinating pain, occurring for the most part after the middle period of life, and passing sooner or later into ulceration.

This definition, it will be perceived, is not so concise as could be desired, yet, on the whole, perhaps as correct an one as can be given, consistently with the present stage of pathological science. Like tubercle, scirrhous has its regular period of growth, maturation, and decay ; and, in order to comprehend, in the fullest manner, the circumstances which modify its physical characters, it will be necessary to study it in its various stages as it affects different textures of the body.

The principal form in which the scirrhous matter is deposited is the tuberoïd, (Pl. III, Fig. 5.) True it is, we sometimes find it diffused through the interstitial cellular tissue of various organs, as the uterus, lungs, liver, kidneys, and bones, which it converts into a solid substance, resembling a slice of raw pork. This rare disease constitutes what some of the French anatomists have termed the *lardaceous tissue*. In this variety of scirrhous, the primitive texture, whatever it may be, gradually loses its normal color and consistence, but the volume of the affected part is seldom much augmented or diminished.

This substance may also appear under the form of a layer, beneath or upon the surface of the serous and mucous membranes, (Pl. III, Fig. 2.) This variety, indeed, is more common than the one just described, and is observed chiefly in the submucous cellular tissue of the œsophagus, the stomach, and bowels. In these situations it is not unusual to find large patches of this description, of a pale bluish tint, crisp, from one to six lines in thickness, and of a dense, fibro-cartilaginous consistence. The lining membrane, together with the muscular tunic, sooner or later participates in the disease ; and the part of the tube corresponding with the seat of the lesion becomes hard, rigid, and contracted.

In the tuberoid variety, the most common, as we have already said, of all the heterologous substances, forms small circumscribed nodules, the number of which, as in the liver, is sometimes very great, and the consistence of which varies between fresh pork and fibro-cartilage. Their size and shape are much influenced by the nature of the tissues in which they are developed, and by the resistance which is offered to their progress. Single tumors of this kind are rounded, ovoidal, or conical ; when, on the contrary, several are agglomerated together, they are generally very irregular, angular, and more or less lobulated. In their size they vary from a mustard-seed to an adult head, — their average volume being that of a billiard-ball, a lemon, or an orange.

A scirrhou tumor creaks under the knife, is opaque, firm, inelastic, and of a white bluish color, with various shades of gray, red, and drab. These tints are most conspicuous when there is an admixture of bile, blood, or pus, as sometimes happens when the heterologous matter is very old. To examine the interior of such a tumor it is necessary to divide it into thin slices. These will be found semi-transparent, flexible, and elastic, and, on being dried, they assume all the properties nearly of the horny tissue. Fibrous intersections, generally of a slight yellowish color, will also be seen to pervade the diseased mass, starting from the centre as their common nucleus, and radiating out towards the circumference. These lines are merely the remains, in most cases, of the cellular substance of the affected part, and are often so arranged as to resemble very closely the fibrous structure of an unripe pear or turnip. A creamy-looking fluid is occasionally incorporated with the heteroclit mass, and constitutes the most decided evidence of its carcinomatous nature.

Scirrhou growths, especially such as occur in the female breast, occasionally contain hydatids. A more common appearance is the developement of cysts, filled with a thin, grayish, gummy substance, meliceric matter, or even pus, though the latter, I believe, is very rare. Clotted blood is likewise present in some instances. By some writers, scirrhou tumors are said to be furnished always with a distinct cyst ; as a general rule, however, this is not the case, and this forms one of their characteristic features. When they are very large and old, the cellular tissue around them is generally a good deal condensed, but seldom to such an extent as to entitle it to the appellation of a capsule. Distinct vessels are very

rarely perceived in them; nor is it possible to discern any nerves.

Scirrhous occasionally exhibits a regularly lobulated arrangement, resembling the section of the healthy female breast. When this appearance is present, it constitutes what Mr. Abernethy has called the *mammary sarcoma*, (Pl. III, Fig. 3.) In other cases, it is of the color and consistence of the pancreas, and is there termed, by the same distinguished writer, *pancreatic sarcoma*, (Pl. III, Fig. 4.) In a third class, the morbid structure has a *lardaceous* aspect, (Pl. III, Fig. 5;) in a fourth, it is *gelatinoïd*, (Pl. III, Fig. 6;) and, in a fifth, it may be essentially *fibrous*, (Pl. III, Fig. 7,) being composed of dense, grayish filaments, which are inextricably interwoven with each other. These are varieties which depend upon the peculiar arrangement, color, and consistence which the scirrhouss substance exhibits in different regions of the body, or at the different stages of its growth.

That the chemical composition of scirrhouss matter should vary in different parts of the body, and in different stages of its developement, as well as in different animals, is a circumstance which readily suggests itself from what we know of some of the other heterologous formations. Upon this point, however, there is very little positive information. The best analysis of this substance, as occurring in the human subject, is by Dr. Hecht. He found seventy-two grains of scirrhouss breast to consist of twenty of fibrin, two of albumen, twenty of gelatine, ten of a fluid fatty matter, and twenty of water. Seventy grains of scirrhouss uterus contained ten of fibrin, fifteen of gelatine, ten of fatty matter, and thirty-five of water.* It will be perceived that, in the latter of these analyses, there is an entire absence of albumen, with a considerable diminution both of fibrin and gelatine; thus showing, as was before stated, that the nature of this substance varies in different organs of the body. The researches of Dr. Hecht have not, I believe, been repeated by other chemists, which is so much the more to be regretted, as they would probably lead to most important results concerning the true character of this singular disease. One thing, however, I think, has been fully established by the experiments of the German philosopher, namely, the close analogy between scirrhouss and tubercular matter.

Scirrhous rarely appears before the age of thirty, in which

* Lobstein, *Traité d'Anatomic Pathologique*, t. I. p. 403.

respect it strikingly differs from encephaloïd. It is much more common in women than in men, and its favorite period of attack is from the fortieth to the fiftieth year. Rarely, perhaps *never*, does it occur before the period of puberty. The lymphatic temperament is said to predispose to it, and in some instances it seems to be connected with a hereditary taint, being transmitted from parent to offspring. In the uterus, mammary gland, and testicle, it has been repeatedly observed in three or four members of the same family. Very often it supervenes upon external violence, such as a blow, kick, or bruise, syphilitic disease, suppression of the menses, and the repulsion of herpetic eruptions. In other cases, again—and these are very common—it arises without any assignable cause. Corroding cares, by impairing the general health, sometimes induce this disease; and, in the female, it is often dependent upon sympathetic action between the uterus and the breast.

Scirrhous sometimes attacks a considerable number of organs in the same individual, either simultaneously, or in gradual succession. In females, for example, it is not uncommon to find both the breast and the uterus involved at the same time. It not unfrequently coexists with encephaloïd, tubercles, melanosis, and hydatids. What I mean by this remark is, that the heterologous formations here specified may affect different organs, or even different portions of the same viscous, or they may all, or at least several of them, occur in the same morbid mass, constituting different sections.

The parts of the body most liable to scirrhous are such as have a glandular structure. In females, it is most common in the breast and uterus; in males, in the testicle, penis, stomach, and rectum. In both sexes the lips, nose, and liver may be mentioned as frequent seats of it. The spleen, lungs, and kidneys are seldom affected. It is also extremely rare in the bones, and it is doubtful whether it ever occurs in the cartilages; in the serous, synovial, and fibrous textures, and in the muscles of voluntary life.

After what has been stated, under the head of the tuberoïd variety of scirrhous, it will scarcely be expected that we should enter into a formal discussion respecting the mode of organization of this disease. There is one theory, however, which demands brief notice, as well from its extrinsic singularity, as from the high source from which it emanates. I need scarcely say that I allude to the well-known doctrine of Professor Carswell, which inculcates the strange notion, that, whilst

encephaloïd is capable of generating its own vessels, scirrus is dependent for its vascular supply upon the surrounding textures. Now, if we look upon scirrus merely as a modification of the coagulating lymph, as we certainly must if we duly contemplate its physical and chemical properties, together with its origin and mode of termination, we must ascribe to it, I think, a self-organizing power, and consequently a proper as well as a collateral circulation. It is not necessary to reiterate here what was said in reference to this subject under the head of tubercle, and what we shall have occasion again to advert to in the next section; and I shall therefore only add one other remark, which is, that the vessels of the heterologous formation in question, whether we regard them with Carswell as being derived from the circumjacent tissues, or as created, in fact, by its own inherent powers, are always much smaller and less numerous than they are in encephaloïd, being so extremely fine and delicate as to escape, in most cases, the naked eye.

Concerning the proximate cause of scirrus, nothing is known with any certainty, notwithstanding the numerous attempts that have been made to investigate it. By some of the older authors, the disease was ascribed to the presence of worms, which, destroying the natural tissues of the part, produced, as they conceived, all the local mischief. Singular as this theory may appear, one very similar to it was broached about thirty years ago, by Dr. Adams, of England. He contends that scirrus uniformly depends upon the presence of a parasitic animal, to which he has given the name of the *carcinomatous hydatid*. Of this he has pointed out three varieties,— the serous, the gelatinous, and the sanguinolent, each of which is capable of exciting, as he supposes, a specific irritation in the part where it occurs, resulting in a deposition of the heterologous substance in question. This doctrine, if such it deserves to be called, has been adopted, with certain restrictions, by Dr. Richard Carmichael, of Dublin, who is still one of its most zealous advocates, as would appear from an essay which he published, a few years ago, on the "Origin and Nature of Tuberculous and Cancerous Diseases." That such is the source of scirrus in some cases, very few, it is to be presumed, will attempt to deny; for it may be easily imagined that hydatids would excite irritations, to some extent at least, in whatever organ they might occur, followed occasionally by a deposition of foreign matter. The circumstance, then, I

would suppose to be within the range of possibility: that it is constant, however, as is alleged by the abettors of this theory, is an assumption, which is not less opposed by analogy, than it is unfounded in fact. If the doctrine were true, hydatids should always be met with wherever there is scirrhus, which, it need scarcely be remarked, is not the case. Instead, therefore, of considering these bodies as the immediate cause of this disease, we are justified in the belief that, in the great majority of instances, they are nothing but accidental growths superadded to the original disorder.

Equally applicable are these remarks to the theory recently proclaimed by Dr. Hodgkin, also an English physician, in his excellent work on the morbid anatomy of the serous membranes. Disbelieving the doctrine which we have just been examining, he maintains that all scirrhou and malignant diseases are produced by the presence of serous cysts. These, which are the result of a new formation, he supposes always exist prior to the heterologous substance, forming so many nests for its reception. The number of cysts is sometimes very considerable: they are generally small, of a globular shape, occasionally pear-like, or pediculated; and their contents vary from a fluid that is perfectly clear and limpid to a substance that is more or less opaque and solid. This theory, which is certainly highly ingenious, has been ably refuted by Professor Carswell, who, however, admits that it holds good in some cases.

The late Mr. Abernethy advanced the idea that all scirrhou tumors are formed from the coagulating lymph, deposited in consequence of inflammation. He fixed their seat in different parts of the body, as the cellular, serous, and parenchymatous textures, and supposed that they became organized, not by any vessels of their own creation, but by the assistance which they receive from the surrounding structures. This theory, on the whole, seems more plausible than any other, and is the one which will be adopted, to a certain extent, in the present work.

It has been already seen that the matter of scirrhus is closely allied to that of tubercle, both in its color, its consistence, and, above all, in its chemical composition. Indeed, no one who studies the subject can help being struck with the remarkable analogy existing between these two heterologous formations. What the precise difference is, or where the connection begins and terminates, we cannot of course say. A

profound study of pathological anatomy, not in books, but in the dead-room, is alone competent to decide the question. Chemistry, too, must lend her aid, and lay the results of her analyses upon the altar of science. In the mean while, it is enough for us to know that there is such an analogy.

Tubercle, as we attempted to show in a preceding section, is always the result of inflammation; and that this is the case likewise with scirrhous, seems sufficiently evident from what has been stated in regard to its exciting causes. Very frequently, it is true, the disease arises imperceptibly, without local injury or obvious constitutional derangement. But this certainly does not prove that inflammation is not concerned in its production. How often do we not find traces of inflammation after death, without having had the slightest indication of it during life. The fact, then, that it is not manifested always by the usual phenomena, does not invalidate the idea of its presence. The opinion that scirrhous and other malignant diseases are caused by inflammatory irritation, is not new. It has been zealously inculcated by Broussais, Breschet, Sanson, and other pathologists of the French school, and has likewise received the sanction of several of the most distinguished writers in Great Britain, Germany, and Italy. The precise nature of this inflammation we cannot of course define: all that can be said about it is, that it is of a specific kind, and that it gives rise to the effusion of a fluid analogous to the fibrin of the blood, and not very dissimilar, consequently, from the matter of tubercle.

The effusion that is thus produced takes place in the cellular element of our organs, the proper structure of which it gradually transforms, effaces, or destroys. That this is the case, is sufficiently evinced by what happens in the liver, the kidney, and the pancreas. Cases occasionally occur, in which the heterologous substance can be discovered in different stages of its development, so as to enable us to determine the manner in which it is deposited. Thus, in the liver, the scirrrous matter generally appears in very minute, circumscribed points, corresponding with the granulations which are so abundantly found here in the natural state. At first, there is merely a change of color, the granulations exhibiting a pale grayish aspect, without the slightest deformity or augmentation of volume. Examined at a somewhat later period, the little tumors are observed to be of a white milky hue, hard, dense, crisp, opaque, irregularly

spherical, and perfectly devoid of the original structure. Now these alterations, it is quite plain, can only be accounted for on the assumption, that, in proportion as the heterologous matter is deposited into the cellular texture of the acini of the liver, their proper parenchymatous substance, whatever it may be, together with their vessels, is obliterated by absorption, the pressure which the accidental secretion produces being fully adequate to bring about this result. Similar phenomena are to be witnessed, as scirrhus is being developed in other organs.

From the foregoing remarks, then, it may be concluded, first, that scirrhus is invariably produced by inflammation; secondly, that it has a great predilection for the glandular viscera; thirdly, that it rarely occurs under the age of thirty; fourthly, that the matter of which it consists strongly resembles that of tubercle; and, in the fifth and last place, that this matter is deposited always into the cellular tissue of our organs, in such a manner as to transform, to a greater or less extent, their proper parenchymatous structure.

After having existed for some time, varying from a few months to several years, the scirrhouss matter manifests a disposition to become soft, the process by which this is effected, like that of tubercle, commencing at different parts of the diseased mass, from which it extends in various directions, until the whole or the greater portion of it is broken up and dissolved. Some authors have contended that the liquefaction invariably begins in the centre; but that this is not true, the writings of pathologists abundantly attest. The process, then, may commence at any point, at the centre or at the periphery, or simultaneously in both these situations; and, as it advances, the superincumbent integuments crack at one or more places, through which the softened matter, now of the aspect of encephaloïd, jelly, sirup, gum, or honey, is ultimately discharged. Ulceration, however, it should be observed, often occurs in scirrhouss tumors long before the internal disorganization in question is accomplished.

A scirrhouss ulcer possesses certain features which may be considered as characteristic. Generally, it is remarkably irregular in its shape, with a surface that is either cracked, fissured, or fungous, of a dark reddish color, and of a peculiar glossy œdematosus aspect. Soft cauliflower excrescences sometimes sprout from it, so sensitive as to bleed on the slightest touch, or even of their own accord. The edges of

the sore are of a reddish-gray color, elevated, everted, irregularly serrated, and harder in some places than in others, emitting more or less sanies on pressure. A deep excavation is occasionally formed, presenting the appearance as if a portion of the diseased mass had been lifted out of its bed. In cases which run their course very rapidly, the surface of the ulcer is frequently covered with a soft, grayish putrilage, of the most intolerable odor.

This fluid, which bathes the surface of the ulcer, is generally of a thin, bloody, ill-conditioned nature, with an odor approaching that of ammonia. It is always highly irritating, and the quantity discharged is sometimes surprisingly great. Dr. Crawford, an English physician, who has particularly examined this fluid, states that it blackens silver, and imparts a green color to sirup of violets. Potash produces no change; but, on the addition of sulphuric acid, a peculiar gas is evolved, having many of the properties of sulphuretted hydrogen. This gas appears to exist in union with ammonia, and gives the fluid its peculiar fetid odor.

In this advanced stage of the disease, the skin around the ulcer is of a purple color — from the overloaded state of its capillaries — hard, pucker'd, somewhat tender on pressure, and easily corroded by the irritating discharges. By degrees, the ulcer spreads, both in depth and in diameter, until at length the whole mass is involved in the disorganizing process, and the patient sinks under the exhausting hectic, caused by the profuse local discharges, and by the violent constitutional irritation. The lymphatic ganglions, it should be further stated, in the neighborhood, are almost constantly enlarged and indurated, and the tumor, instead of being movable and circumscribed, as it was in the early stage of its growth, forms a hard, solid, undefined mass, which firmly adheres to the surrounding structures.

Scirrus is recognized by its circumscribed character, its hardness and incompressibility, and by the peculiar nature of the accompanying pain. The hardness is greater than that of any normal texture, save the cartilaginous and osseous. The pain is usually of a gnawing, lancinating kind, darting through the swelling in different directions, and coming on in irregular paroxysms, which, as the disease progresses, increase both in frequency and violence, as well as in duration. Sometimes it is prurient, hot, burning, or scalding, and is then commonly more permanent. At first, the tumor,

as was before stated, is movable, distinctly circumscribed, and the skin over it perfectly natural ; by and by, however, it contracts adhesions, and soon becomes fixed and less defined, at the same time that its cutaneous covering experiences various alterations, both as respects its smoothness, its color, and its consistence. These remarks are intended, of course, to apply solely to external scirrhous growth : when they are seated internally, the diagnosis is always difficult, nay, often impossible to be made out.

SECTION IV.

Encephaloïd.

INTIMATELY allied to scirrhous, in its mode of origin, yet differing from it widely in many of its essential features, is encephaloïd, one of the most formidable and destructive of the heterologous formations. As the term indicates, this morbid growth bears a great resemblance to the cerebral tissue, not only in appearance, but also in chemical composition. For the first accurate account of it, we are indebted mainly to Mr. John Burns, of Glasgow, who described it under the name of spongoïd inflammation. The observations of this eminent surgeon soon attracted the attention of other pathologists, both in Great Britain and on the continent of Europe, and, as might have been expected, led to further and more thorough investigation. Amongst those who have particularly distinguished themselves in this respect, may be mentioned the names of Hey, Abernethy, Wardrop, Laennec, Roux, Maunoir, and Carswell. Most of these writers have designated the disease by a different appellation, according to the peculiar notion which they entertained of its composition and structure. Thus Abernethy has called it medullary sarcoma ; Hey, fungus haematoïdes ; Roux, soft cancer ; Maunoir, medullary fungus ; and Mr. Burns, as already stated, spongoïd inflammation. The term encephaloïd, devised by Laennec, seems, on the whole, less objectionable than any other, and I shall therefore retain it on the present occasion.

The most common seats of this morbid growth are the bones, eyes, testicles, liver, lungs, kidneys, uterus, lymphatic ganglions, and subcutaneous cellular tissue. In infants it often occupies the shoulder, the region of the clavicle, the side of the chest, and the fore-arm. In adults I have seen a number of cases where it attacked the hand and fingers. Never have I observed it in the inferior extremities; but that it sometimes occurs here, the writings of pathologists abundantly testify. Encephaloïd has likewise been noticed in the veins, especially in those of the liver, of the kidney, and the uterus.

The varieties of form under which the encephaloïd matter is deposited are three,—the tuberoid, the stratiform, and the infiltrated, to each of which it will be proper to devote a few remarks.

In the tuberoid variety, (Pl. IV, Fig. 1,) the heterologous matter appears in the form of a circumscribed tumor, from the size of a pea to that of a muskmelon. In its shape it is generally irregularly rounded, ovoidal, or even quite flat, according to the amount of pressure that is exerted upon it by the surrounding parts; and, if it be examined by dissection, it will be found to be composed of different lobules, enveloped by a thin covering, and separated from each other by delicate membranous partitions. The outer covering, which is evidently formed out of the neighboring cellular tissue, is usually not more than half a line in thickness, easily torn, semi-transparent, and of a light rose color. From its inner surface are detached numerous processes, which, dipping into the morbid growth in various directions, form so many cavities for the reception of the new deposit. These septa, which are sometimes remarkably rough and shreddy, always become more obvious after the pulpy mass is squeezed out. The cells which they form by their intersections, are subject to much variety, and hence the peculiar lobulated shape which characterizes the morbid growth when occurring in parts that offer little or no obstacle to its extension.

Although the covering of encephaloïd tumors is ordinarily derived from the preëxisting structures in their immediate vicinity, yet cases occasionally occur in which it is evidently of new formation. That this is true, my own dissections fully convince me. In such cases, the external envelope is generally very thin; sometimes, indeed, almost like a film,

easily lacerated, and of a grayish color, with rough, shreddy surfaces. The interior septa are likewise less perfect, and the whole mass is commonly so soft as to yield to the slightest force.

The external envelope, together with the internal processes here described, is abundantly supplied with vessels which pervade the diseased mass in different directions, assist in its growth, and maintain its vitality. These vessels, which always consist of a much greater number of veins than of arteries, are often remarkably large and convoluted, and can be easily traced to the neighboring vascular trunks: their walls are exceedingly brittle, and the most trifling accident is therefore liable to be attended with an effusion of blood. Hence the dark clots which are so frequently met with in encephaloïd tumors. The cerebriform substance itself, it should be stated, is easily squeezed out of its cavities, owing to its imperfect adhesion; and, interspersed through different parts of it, we frequently observe, besides the sanguineous deposits just adverted to, small cells filled with purulent matter, serum, or thin, sanious, and offensive fluid. In one case, I saw as much as half a pint of reddish serosity flow from a single cavity, the inner surface of which had a peculiar hon-eycomb-like appearance.

When developed beneath the pleura and peritonæum, these tumors generally assume a pear-shaped appearance, the foot-stalk, by which they are attached, being often quite slender, (Pl. IV, Fig. 2.) In their volume they vary between that of a pea and a walnut: they are of a dirty straw-color, and of a semi-concrete consistence. Although commonly isolated, they sometimes occur in groups, and are always distinctly encysted,—the capsule which covers them being either of new formation, or, as more frequently happens, derived from the serous membrane beneath which they are developed. This species of encephaloïd is rare.

The stratiform variety, (Pl. IV, Fig. 3,) is exceedingly rare, and hitherto I have not met with it except in a few instances. It is found only in the subserous cellular tissue, principally in that of the pleura and arachnoid, in circular patches, from the diameter of a pin-head to that of an American dollar. The deposit is generally of a whitish, cream-like color, tolerably hard and dense, and from the fourth of a line to the twelfth of an inch in thickness. Several such patches occa-

sionally run together, and thus form an irregular layer of considerable extent, over which the serous membrane is considerably indurated and puckered.

The encephaloïd matter is sometimes infiltrated into the substance of our organs, (Pl. IV, Fig. 4.) This variety, which is likewise very uncommon, is seen principally in the uterus, liver, and lungs, where it forms small, irregular masses, of a semi-concrete consistence. In the situations here referred to, the heterologous substance usually partakes more or less of the color of the parts into which it is deposited, and is often distinguished with difficulty from the tubercular infiltration described in a previous section.

The color of the heterologous substance, although generally inclining to cineritious, runs through various shades of white and red, having either the yellowish aspect of cream, the complexion of jelly, or the black appearance of the crassamentum. In the tuberoïd species, it is not unusual to see different sections of the morbid mass present different shades of color, one part being pale, another cineritious, and a third of a deep brown, from the intermixture of clotted blood. It is seldom that the tumor has the pure white aspect of the medullary substance of the brain.

The consistence of this heterologous growth is also subject to much variety. Though in general pretty nearly that of the foetal brain, it is sometimes as soft as cream, and at other times almost as hard as fibro-cartilage. Like the tubercular matter, it is supposed by Laennec, Lobstein, and others, to be originally deposited in a concrete state. But for this opinion there seems to be no just ground; and I feel, therefore, disposed to reject it,—the more so as it cannot be supported even by a single argument drawn from analogy. The error into which these, together with some other anatomists, have fallen, may be readily explained, it seems to me, by the fact that the heterologous matter varies in its physical and chemical properties, not only in the different organs of the body, but often in different sections of the same mass. Thus, we frequently find encephaloïd tumors hard and lardaceous in one part, semi-concrete and medullary-looking in a second, pulpy and cineritious in a third. That these differences of consistence, as well as of color, are the result, in some degree at least, of changes affected in the morbid substance after the deposition has taken place, will, I presume,

scarcely be denied. We would therefore say of this matter what was previously said of the tubercular, — that it is never poured out in any other than a fluid state, whatever may be its consistence at the time it is examined, whether concrete, pulpy, or semi-liquid.

No very accurate analysis has yet been furnished of the substance under consideration, which is so much the more to be regretted as it might throw considerable light upon its nature and origin. From an examination made by my colleague, Professor James B. Rogers, of a specimen of encephaloïd tumor of the elbow, it would appear to be essentially composed of the same ingredients as the cerebral texture, containing, like it, a considerable quantity of albumen and fatty matter, together with certain earthy salts. It is of a viscid, jelly-like consistence, emits a peculiar spermatic odor on being heated, and readily coagulates when steeped in alcohol.

Concerning the mode of organization of this substance, especially the tuberoïd variety of it, we have already made some remarks; and it will only be necessary, therefore, in connection with this subject, to advert briefly to the ingenious doctrine that has been recently advanced by Professor Carswell, of London. This distinguished anatomist supposes that encephaloïd matter, like coagulating lymph, is always endowed with a high degree of vitality, in virtue of which it is qualified to create its own vessels. These, it is contended, often arise in the midst of the morbid deposit, from whence they gradually extend towards its circumference, where they finally anastomose with arteries and veins in their immediate vicinity. If this view be adopted — and I cannot myself see any particular objection to it — encephaloïd will be found to have two circulations, one of them proper to the diseased mass, the other common to it and the surrounding structures. Owing to this peculiarity of its vascular system, it often grows with great rapidity, so as to attain a frightful magnitude in the course of a few months. For the same reason it is very prone to bleed, the new vessels, which are usually very imperfectly organized, being exceedingly liable to be ruptured on the slightest injury. Nerves probably exist in considerable abundance in encephaloïd, though it is a singular fact that this disease is generally much less painful than scirrhus. Whether they are of new formation,

or derived from the tissues in which the morbid growth is developed, is a point for the determination of which we have no data.

How does this substance originate? Desirable as it certainly would be to give a satisfactory solution of this problem, it must be confessed that any attempt of the kind would be likely, in the present state of the science, to prove abortive. The opinion of Dr. Maunoir, of Geneva — that the encephaloïd matter is effused by the nerves when under the influence of some peculiar morbid state — although highly ingenious, is entirely unsupported by facts, and cannot, therefore, receive the sanction of the pathologist. The circumstance that this substance has been found in the blood, is of no small moment in the discussion of this question. It would lead to the inference that, when the sanguine fluid is surcharged with it, the cerebral matter, instead of being deposited in the brain, spinal cord, and nerves, is poured out into the meshes of the cellular element of one or more of the organs of the body. This conjecture is so much the more plausible, as the encephaloïd disease often arises without any assignable cause, is sometimes decidedly hereditary in its tendency, and almost always existing in several situations at the same time. Chemical analysis, also, comes to our aid here, bringing to light the important fact that the cerebral tissue and the heterologous deposit are essentially alike in their character. Nor is analogy without its utility in a discussion of this kind. Cholesterine, the crystalline matter which constitutes the basis of biliary concretions, is frequently formed in parts of the body which have no connection whatever with the hepatic circulation, in consequence merely of deranged vascular action. Christison found it in the fluid of hydrocele; Breschet, in a tumor under the tongue; Caventon, in an abscess of the jaw; and Barruel, in an ovarian cyst. Thus we see that a substance which is naturally confined to one organ may, by a perversion of the secretory function, be deposited in another, totally unlike it in structure and office. Similar illustrations, it is obvious, might be adduced from other parts of the body.

Encephaloïd is emphatically a disease of early life, being most generally observed in children under the age of ten years. Occasionally, indeed, it makes its appearance soon after birth. In a few rare cases, I have seen it in adults and in persons far advanced in life; and I have also thought that

it was more common in females than in males. However this may be, it is certain that I have seen five instances in the former to one in the latter. Upon this point, however, I would speak with caution, as my experience has been too limited to enable me to make any positive assertion. The disease is of very frequent occurrence in Europe, as well as in certain districts of America, and is often observed in the inferior animals, especially in the equine genus. Although *encephaloïd* is sometimes grafted on *scirrhus*, it generally exists as a primitive affection, which in its progress becomes associated often with tubercles, melanosis, hydatids, and other lesions. One of its most constant features, as already hinted, is, that it manifests itself simultaneously in different organs, and not less extraordinary is its disposition to reappear after extirpation, either in the original seat, in the structures immediately around, or in remote parts. An interesting case of *encephaloïd*, well calculated to illustrate this renovative tendency, is detailed by Mr. Allan, of Edinburgh.* The patient suffered during thirteen years from a very large tumor which occupied the left hip, and was operated upon not less than five times by different surgeons. Within several months after each extirpation, the disease usually reappeared, and soon attained the volume of a child's head. This case, certainly one of the most extraordinary and instructive of the kind on record, plainly shows the futility of any attempt at removing this disease, save by amputation ; and even this, unfortunately, is often only of temporary benefit. Nor will this seem so singular, when we consider, as unquestionably we must, that this disease is of a constitutional origin, and that the deposits to which it gives rise are only so many local manifestations.

Encephaloïd disease, after having attained a certain development, may remain stationary for years, unaccompanied by the slightest uneasiness, until the part receives some injury, when it often grows with frightful rapidity. When seated in the subcutaneous cellular tissue, the tumor that is thus formed is at first quite movable, smooth on the surface, and devoid of sensation ; but gradually, as the enlargement progresses, it becomes stationary, irregularly lobulated, elastic to the touch, and more or less painful. If allowed to pro-

* *Surgery*, vol. i. p. 261.

ceed, the diseased mass has a tendency to open and protrude, generally by ulceration, sometimes by sloughing, and occasionally by the bursting of an abscess situated in its interior. In either case, the exposed surface presents a dark reddish fungous appearance, is highly sensitive, extremely vascular, very prone to hemorrhage, and constantly bathed with a thin, fetid, irritating, sanguous fluid, the quantity of which is sometimes quite profuse. In many instances, pure blood is effused, caused by a rupture of some of the vessels of the morbid growth; and this may be so obstinate and copious as gradually to destroy the patient. Occasionally there is a discharge of thin, glairy fluid, resembling the white of egg. Such sores, besides being always highly disagreeable, never heal, from the inability of the parts to form healthy granulations. Sometimes the ulcerated mass sloughs as completely away as if it were dissected out; but these cases are uncommon, and are soon followed by a reproduction of the heterologous substance.

Obstinate hemorrhage is most apt to occur in such tumors as are of the class to which Mr. Key applied the term *fungus haematoches*. In the eye, for example, much more frequently than elsewhere, the morbid growth, if it be permitted to go on unrestrained, is extremely prone to bleed. The reason of this is obvious. The diseased mass is almost always composed, in part, of a vascular, erectile tissue, interspersed with encephaloïd matter, and, as soon as ulceration sets in, hemorrhage, occasionally to an alarming and even fatal extent, is the consequence. The eroded surface, in these cases, is pale, livid, or mahogany color, and studded with large fungous excrescences, so grouped together as to resemble a cauliflower.

In this advanced stage of the disease, there is a rapid failure of the strength, the flesh wastes, the appetite declines, the patient is harassed with hectic fever, and the countenance assumes a peculiar yellowish, cadaverous hue. The lymphatic ganglions in the neighborhood meanwhile become enlarged, and converted into a substance resembling that of the original tumor. Two modes of explanation may be offered to account for this phenomenon. The one supposes that these bodies are affected merely sympathetically, in consequence of which their vessels pour out encephaloïd matter; the other, that this substance is carried to them by absorbent

vessels coming from the affected part. Although this enlargement of the lymphatic ganglions seldom occurs before ulceration sets in, yet, in a few instances, I have known it to exist at an early period after the developement of the heteroclite mass, a good while before the skin covering it manifested a disposition to give way.

The diagnosis of an encephaloïd tumor can, in general, be easily determined by its history, consistence, and situation. In most instances, as has been already stated, the morbid mass is soft, elastic, and slightly fluctuating, with an irregularly lobulated surface. The skin exhibits a peculiar glossy aspect, and the subcutaneous veins are enlarged, tortuous, and of a beautiful bluish color. The pain that attends it is extremely uncertain, being sometimes scarcely perceptible, at other times very severe, sharp, and lancinating. Add to these symptoms the fact that encephaloïd is essentially a disease of early life, and that it often occurs in situations where scirrhous is never found, and no difficulty can arise in coming to a correct decision in regard to the diagnosis.

P A R T I I .

S P E C I A L

P A T H O L O G I C A L A N A T O M Y .

PATHOLOGICAL ANATOMY.

CHAPTER I.

Of the Blood.

Physical Properties.—Chemical Analysis.—Division into Serum, Fibrin, and Hematosine.—Lesions of the Blood.—Nature and Formation of the buffy Coat.—Cupped appearance of the Blood.—Want of Coagulability.—Relative quantity of Fibrin in healthy and diseased Blood.—Alterations of the Hematosine.—Lesions of the Serum, in Inflammation, Dropsy, and other Maladies.—Changes of the Blood, from acceleration of the Circulation and Division of the Pneumo-gastric Nerves.—Appearances in Cholera, Fever, Chlorosis, and Scurvy.

THE blood, derived from the chyle and lymph, is a thick, opaque fluid, contained in the heart and arteries, the capillaries and veins, by which it is distributed, as by so many canals, to every part of the animal fabric. Examined as it flows from the arm, it is of a dark reddish color, slightly saline to the taste, somewhat viscid to the touch, of the average temperature of 96° of Fahrenheit's thermometer, and apparently homogeneous in its nature. On remaining at rest, however, for about three minutes and a half, it begins to concrete, and, finally, in about three minutes and a half more, it separates into two parts, one of them, thin and watery, termed the serum of the blood, the other, red and solid, named the crassamentum, cruor, or clot. The process by which this disunion is effected is denominated coagulation, and generally requires from five to twenty hours for its completion.

Respecting the actual quantity of blood contained in the entire body, our means of appreciation are altogether too inaccurate to enable us ever to arrive at any satisfactory conclusions. Fixing the ordinary standard of the adult human body at one hundred and fifty pounds, it may be supposed that the average amount of blood is about eighteen pounds, of which eleven are contained in the veins, seven in the

arteries. This estimate nearly coincides with that of Sir Astley Cooper, who, from an experiment performed on a small dog, was led to infer that the proportion of the blood, as compared with the solids, is as one to sixteen. Fortunately, it is not of much practical importance whether our data on this point are correct or not, since in the abstraction of blood from the system, the merest tyro in the profession is governed, not by the amount or quantity, but by the effects it produces on the individual.

From the great discrepancy still existing among authors concerning the specific gravity of the blood, it may reasonably be presumed that it varies, not only in different persons, but even in the same individual, at different periods. Compared with water, its mean specific gravity is generally stated to be as 1052 to 1000; or, in other words, as about one twentieth part heavier than that fluid. In ten observations, I found it range from 1002, the minimum, to 1031, the maximum. According to some, however, it has been found as high as 1126; but this, if true, must be regarded as an exception.

Various attempts have been made to ascertain the different constituents of the blood of the human subject. The latest and most complete analysis that we possess, is that published by Dr. Lecanu, a distinguished chemist of Paris. A careful examination of the blood of two robust, healthy men afforded the following results: *

Water,	780.145	785.590
Fibrin,	2.100	3.565
Albumen,	65.090	69.415
Coloring matter,	133.000	119.626
Fatty crystallizable substance,	2.430	4.300
Oily matter,	1.310	2.270
Extractive substances soluble in alcohol and in water,	1.709	1.920
Albumen combined with soda,	1.265	2.010
Chloruret of potassium and sodium, together with alkaline subcarbonates, phosphates, and alkaline sulphates,	8.370	7.304
Subcarbonate of lime and magnesia, with the phosphates of these salts and of iron,	2.100	1.414
Loss,	2.400	2.586
Total,	1000.000	1000.000

* Ann. de Chemie, 2de serie, t. xxiii.

Since this analysis was made, Dr. Boudet, another French chemist, has shown that the fatty crystallizable substance above mentioned is identical with cerebrine, discovered by Vanquelin in the brain, and that the oily matter is a mixture of cholesterine and an alkaline soap, similar to that which is met with in the bile.*

From these results it follows, that the blood, instead of being a homogeneous fluid, as it would seem to be before it has undergone coagulation, consists of a great number of ingredients, existing in various proportions, and differing from each other essentially in their character. To these, chemistry, which has of late years been making such rapid progress, will no doubt add others, until the list will be swelled far beyond what it is at present.

So much respecting the nature and composition of the blood, considered as a mass. Let us now make a few remarks concerning its three grand constituents,—the serum, fibrin, and hematosine.

Serum, when pure, is of a yellowish straw-color, slightly tinged with green, of a saltish taste, unctuous to the touch, and perceptibly alkaline. Its medium specific gravity is about 1029, or a little greater than that of the *cruor*, though this is by no means constant, as the latter not unfrequently sinks in it. From the analysis of Berzelius, it would appear that one hundred parts of serum are composed of about ninety parts of water, eight of albumen, and the remainder of earthy salts. Besides these ingredients, Dr. Lecanu has recently detected in this fluid both an oily and a fatty matter, in the proportion of one part of each to one hundred of serum.

Serum is readily coagulated by heat; and the same result is produced, though less perfectly, by alcohol, a solution of corrosive sublimate, and the dilute mineral acids. On being cut into thin slices, and subjected to pressure, the hardened albumen yields a transparent watery fluid, holding in solution about one fiftieth part of its weight of animal matter, the precise nature of which is unknown, together with a little muriate of soda. This fluid, it may now be observed, is technically called the *serosity*; and for the first account of it we are indebted to Dr. Butt, of Edinburgh, who directed the attention of the profession to the subject in 1760.

* Op. cit. t. lii.

Very recently, M. Boudet, a French physician, has detected another substance in the serum, to which he has given the name of *serosine*. It is a white, slightly opalescent matter, fusible at about 94° of Fahrenheit, insoluble in water, but soluble in alcohol, and containing, apparently, a minute quantity of azote. Thus serum would seem to be a very compound substance.

The *crassamentum* is a thick, opaque, spongy mass, of a dark reddish color, somewhat lighter, as a general rule, than the serum in which it floats. If it be washed for some time under a gentle stream of water, it may be separated into two portions, one of which is solid, and constitutes what is denominated the *fibrin* of the blood, while the other, dark and soft, essentially consists of *hematosine*: these two substances exist in varying proportions. The weight of the *fibrin* usually exceeds that of the serum, but is less than that of the *hematosine*. In twenty experiments by Lecanu, the medium amount of *fibrin* in one hundred parts of blood was four, from which it ranged from one, the minimum, to seven, the maximum.

Hematosine is invariably heavier than *fibrin*, on which account it generally subsides to the bottom of the *crassamentum* during the coagulating process. Its relative proportion to the other constituent principles varies remarkably in different individuals, so that no very accurate information has yet been obtained respecting it. Berzelius calculated that it formed about sixty-four parts of the *cruor* in the one hundred; but, according to the more recent researches of some of the French chemists, the amount is considerably less. This substance, it need scarcely be said, is intimately connected with the globules of the blood, and is always of a deeper hue, in proportion to the health and vigor of the animal. The globules themselves are of a spherical figure, and about the three thousand and five hundredth part of an inch in diameter.

Concerning the nature of *hematosine*, chemists are still at variance. According to the analysis of Michaelis, it appears to consist essentially of the same ingredients as *fibrin* and *albumen*, with the addition of a small amount of iron, which the other elements want. Berzelius was the first, I believe, to announce this substance, the existence of which was questioned until about fourteen years ago, when it was fully established by Dr. Engelhart, of Germany. From the fact that iron resides exclusively in the *hematosine*, it was natural to

suppose that it imparted to that matter its peculiar color,—an idea, which, as has been suggested by the late Dr. Turner, of London, receives additional support from the well-known tendency of the peroxide of that metal to form red salts. It is, nevertheless, highly probable that its presence is merely accidental, and that the coloring substance is a peculiar animal principle, capable, like madder, of acting as a dye, and of combining with metallic oxides, the most effectual of which are those of tin and mercury.

Such is a rapid sketch of the appearances which this fluid presents in the healthy state. Let us now turn our attention to some of the principal alterations which it undergoes in disease.

Although I do not feel disposed to attach that great importance to the blood which the advocates of the old humoral pathology did, yet it cannot be denied that it is decidedly the most essential fluid in the animal economy, inasmuch as it furnishes the various materials which dispense vitality and nourishment to the different tissues, as well as vigor to its several organs, serving thus, in the expressive language of our medical ancestors, as the *pabulum* of life. From it all the solids are formed, and all the other liquids secreted; and hence it may justly be considered as the basis of every part of the complicated fabric, as, without it, it would be utterly impossible for any growth, whether healthy or morbid, to take place. Pervading every portion of the body, and penetrating every fibre, however minute, or however constituted,—acquiring constantly new properties as it passes through the lungs, and losing them again as it meanders through the rest of the system,—it is in the highest degree probable, that, whilst it thus fertilizes the various structures, it may convey to them alike the elements of general health and of general disease. So long as it preserves its integrity, the impression which it makes upon the solids must be of the most salutary kind, calculated to stimulate the whole machine, and rouse it to the proper performance of its functions. Any departure from this state, although so slight as to escape our notice, would be followed, it is reasonable to presume, by a corresponding derangement in the hard parts. In inflammatory affections, it undergoes most important changes, exhibiting frequently, as will be presently seen, a peculiar buff-colored aspect: in dropsey, it is thin and pale, like weak claret; in plethora, on the contrary, it is thick, remarkably tenacious, firm, and of a deep

red complexion. If it be imperfectly elaborated, a morbid diathesis is established, which often lays the foundation of mortal maladies, and which is transmitted, in many instances, from the parent to the offspring. In this way "God visits the iniquity of the fathers on their children, down to the third and fourth generation," as is exemplified in the hereditary predisposition to arthritic and tubercular diseases, mental imbecility, and a host of other disorders, as afflicting to the patient as they are generally perplexing to the practitioner.

In the further discussion of this subject, I shall describe, in the first place, the lesions of each of the three grand constituents of the blood; and, secondly, its alterations in reference to the entire mass.

The most remarkable change which the fibrin of the blood experiences, and one which we have more frequent opportunities of observing in this country than any other, is that inflammatory condition which gives rise to what has been termed the *buffy coat*, or, from its frequent occurrence in acute disease of the serous lining of the thoracic cavity, the *pleuritic crust*. In general, it presents itself in the form of a thin lamella, of a pale straw-color, which is spread over and closely adherent to the upper surface of the crassamentum, looking a good deal like a sheet of tallow. In some instances, it is of the color of a lemon-rind, nearly white, or greenish. The latter appearance is especially conspicuous in the blood of pregnant females, and has been considered by some, though erroneously, to be an indication of that particular state.

The formation of the *buffy coat* is always consequentaneous with the process of coagulation, appearing at first like an opaque, viscid crust, of a reddish opaline tint, and of a consistence equal to that of mucus, which is either diffused over the whole surface of the fluid, or occurs in small insulated spots, looking like so many little islands in the midst of a body of water. Whilst warm, this substance is remarkably tenacious, and may be drawn out in the form of little filaments, which, on cooling, assume a white or reddish aspect. When fully formed, which, however, it is not under some hours, the *buffy coat* is dense, clastic, slightly diaphanous, strongly adherent to the eruor, which it covers, smooth on its free surface, and rough on the other. Now and then it is remarkably soft, and reticulated, or like the interior of a honeycomb, from the developement and rupture of little air-vesicles.

If the *buffy coat* be carefully separated from the crassa-

mentum, washed in cold water, and then immersed in strong alcohol, its elastic properties will be greatly augmented, and the membrane will present the appearance precisely of a half-tanned hide, or of the proper uterine tissue during pregnancy. In this way I have prepared several beautiful specimens, which have now been in my museum of pathological anatomy for several years.

Various accounts have been published respecting the *chemical* constitution of the buffy coat, but it is to the researches of Dowler and Gendrin that we are indebted for the most precise information. From the observations of these physicians, it clearly appears that this substance is essentially composed of fibrin, containing a considerable but variable amount of albumen and serum, or what Dr. Babington has termed the *sanguineous liquor*, which may be squeezed out by pressure. The greatest analogy thus exists, both as regards appearance and chemical composition, between the buffy coat of the blood, as exhibited in certain diseased states of the system, and the substance that constitutes the adventitious membranes of the serous cavities.

Considerable diversity prevails in respect to the *thickness* of the buffy coat, this depending on the intensity of the disease, and the nature of the affected part. Most commonly, it does not exceed the eighth of an inch ; but, in some rare instances, I have known it to be from three to six lines. As a general rule, it may be stated to be greater in plethoric subjects than in such as are weak, and in inflammations of the joints, serous membranes, and parenchymatous organs, than in similar diseases occurring in other structures.

The consistence of the buffy coat is also liable to vary. In typhus, scurvy, and chlorosis, — in short, in all cachectic states of the body, it is generally soft and brittle, thin, iridescent, and of a dirty yellowish color. On the contrary, in simple inflammatory affections, it is usually highly tenacious, thick, and of a uniform opaline tint.

This peculiar appearance of the blood, it may now be observed, occurs in all inflammatory disorders, and, in fact, in almost every condition of the system in which there is a predominance of vascular action. It is usually found in the acute stages of pneumonitis, hepatitis, scarlet fever, small-pox, gout, rheumatism, and invariably, perhaps, in pleurisy ; at least, I do not remember ever having bled a patient laboring under this affection in whom the blood was not more or less buffed.

It is also very generally met with in pregnant women, in dropsy, in chronic diseases of the chest and abdomen, in scurvy, in chronic gout and rheumatism, and in those who resort to frequent venesection. In chronic inflammation, in whatever tissue or organ seated, the buffy coat usually continues for a long time, especially if it be attended with much constitutional disturbance, reappearing at almost every repetition of the bleeding until the malady wholly subsides. The same phenomenon is witnessed in those affections in which the primary morbid impression seems to make on the circulating current, as small-pox, for example, the virus of which is evidently absorbed by the vascular system. At the commencement of this disease, the blood is usually covered with a tolerably thick crust, but this crust seldom exists, or, at most, only in a very slight degree, prior to the establishment of the eruptive fever. When the exanthem is moderate, the quantity of buffy matter is commonly very small : in nearly all cases it continues until the scabs are perfectly dried, and occasionally even a few days later. Baglivi, one of the most celebrated physicians of the seventeenth century, has justly remarked, that the presence of a thick inflammatory crust, at the beginning of small-pox, is a sure indication of a plentiful crop of pustules, — a fact which has been amply verified by more recent observation.

Persons sometimes labor under intense inflammation, and yet the blood does not exhibit the buffed appearance until after they have been bled several times. The reason of this is not very obvious ; but we may suppose that the system in these cases is so surcharged with blood, or that the heart and vessels are so exhausted that the usual nervous energy upon which the slow coagulation of this fluid depends is not imparted. At other times, the reverse of this obtains, — the blood which flows first exhibiting the buffy coat, whilst that which is drawn towards the close of the operation will have little or none of it. This phenomenon is particularly apt to take place when the blood is allowed to issue slowly from a small orifice.

Occasionally, again, the buffy coat can be obtained at pleasure, as when, after having abstracted a small amount of blood, we close the vein for eight or ten minutes, and then finish the operation. The last portion of fluid thus obtained will have little or no buff, unless this appearance is very conspicuous on the surface of the portion first drawn.

From this it may be concluded the first effect of every small bleeding, when the system labors under an inflammatory dia-thesis, is the disappearance of the immediate elements of the fibrinous crust; and that, if this state continues, these elements are speedily reproduced. Hence, as was previously intimated, it may frequently happen, in bleeding a sick person, that the blood which is taken away at the outset of the disease shall have no buffy coat, whilst that drawn subsequently, shall exhibit it in a very high degree. Under such circumstances, too, if the patient be bled to syncope, and then, waiting until he has recovered, abstract more blood, it will be found that it does not present the pleuritic crust.

The manner in which the formation of the buffy coat may be modified by the state of the nervous system, is well illustrated by a case related by the late Dr. Hewson, of England. A young, robust man was bled during an attack of inflammatory fever. On opening the vein, the blood merely trickled down the arm, owing, apparently, to the fright of the patient; but, in a few seconds, it began to run quite freely. Three ounces were then received into a second cup, and a like quantity was immediately caught in a third. The individual now became faint, and was laid on the floor, when a few drachms more blood were taken in a fourth cup. Of these four measures of fluid, that which was removed last coagulated in three minutes, the first in twelve minutes, and the second in about twenty-two minutes. Neither of these had any inflammatory buff; but the blood received into the third cup began, in five minutes, to appear transparent on the surface; and, although it did not fully coagulate for upwards of half an hour, it had a remarkably thick, tough crust.*

The immediate cause of this appearance is sufficiently obvious: the globules, with their coloring matter, begin to sub-side before the coagulation is completed, and thus the upper surface of the crassamentum is left without them. With regard to the remote cause, it can scarcely be said to be fully ascertained, notwithstanding the numerous attempts that have been made to discover it. Hewson thought that the fibrin was rendered specifically lighter than the red globules, by which the latter would be disposed to sink to the lower part of the *cruor*; he also supposed — which, however, is not true — that the blood always coagulated more slowly. Dr.

* *Hewson on the Blood*, vol. i. p. 82, et seq.

Dowler, an English physician, who published an account of this theory in 1822, endeavored to explain the phenomenon on the assumption that inflamed blood contains an unusually large proportion of serum, which, by diminishing its viscosity, readily allows of the subsidence of the hematosine. Neither of these opinions, it seems to me, affords a satisfactory solution of the difficulty.

That the red particles are specifically heavier than the fibrin, is a circumstance with which every one is familiar; but as this is the case even in the sound state, very little use can be made of it as a proof of the position assumed by Hewson. Nor is it, as I before intimated, a fact that inflamed blood retains its fluidity a much longer time than healthy, as is asserted by the same ingenious author. In the great majority of instances, indeed, the very reverse of this obtains,—the concretion taking place with extraordinary rapidity. If this be true—and multiplied observations induce me to think it is—it is obvious that another explanation must be sought for. Shall we adopt the idea of Dowler,—that the phenomenon depends upon a redundancy of thin serum? This also is inadequate, for the fact, if it be one, remains to be established. The explanation which I would propose is this: in the healthy state, the fibrin is exceedingly tenacious, and the red particles are so intimately connected with it as to render it impossible for them to subside during the coagulation, however slowly this may be effected. In inflammatory affections, on the contrary, this cohesive property is either greatly diminished, or, what is more probable, the fibrin loses its affinity for these little bodies, which consequently gravitate to a greater or less depth before before the blood separates into its two grand constituents. In this manner the top of the crassamentum is covered with a buff-colored layer, the thickness and density of which vary according to the repulsive power existing between the two elementary principles referred to, the intensity of the disease, the general state of the system, and the extent of the contraction of the inspissated mass. The reason why this separation is not effected whilst the blood is circulating within its vessels, is the constant motion to which it is subjected, which is incompatible with the process. How far the explanation here offered is correct, I cannot pretend to determine: I throw it out merely as a hint, in the hope that others may be induced to test its truth, or point out its fallacy.

Every physician knows how much the formation of the buffy coat is influenced by extraneous circumstances. Of these, the most important are the shape and capacity of the receiving vessel, the degree of motion to which the blood is subjected, and the size of the orifice in the vein. Dr. Belhomme, of Paris, who has minutely investigated this subject, in a series of one hundred and fifty experiments, has come to the conclusion, that a narrow basin, a large orifice, and a full, rapid stream, in the form of an arch, are the external circumstances most favorable for producing the buffy coat. The results of these researches have since been verified by those of Gendrin* and other physiologists; and they are well worthy of being remembered, as they have a direct bearing on the practice of our profession.

If blood be drawn simultaneously from both arms, it will generally be perfectly uniform, both as respects the quantity of the serum, and the density of the *cruor*. Should the blood, however, run disproportionately slow on one side, there will be no appearance of inflammatory crust, whilst it will readily form on the blood which issues from the other, for the obvious reason, that in the former case the liquid will concrete before the red globules have time to disengage themselves from the fibrin; whereas, in the latter, the fluidity will be sufficiently protracted to admit of this occurrence. This circumstance is alluded to by the sagacious Rush, in his "Defence of Blood-letting," published soon after the beginning of the present century. In a case of pleuritis, the blood which was taken from one arm, he observes, was sizy, whilst that which flowed from the other was of a scarlet hue; and similar appearances were noticed by him in the blood of a pregnant female.

It will be seen, from the foregoing remarks, that we cannot, as a general rule, consider the inflammatory crust as depending uniformly upon the shape of the receiver, the size of the orifice, or the volume of the stream, since all these circumstances merely modify, but can never produce the buffy coat, unless the fluid is susceptible of it, or has undergone those changes which are necessary for its development. Nevertheless, it should be constantly borne in mind, when we wish to draw any legitimate conclusions in relation to the inflammatory crust, that it is all-important

* *Historie Anatomique des Inflammations*, t. ii.

that the blood should not be exposed to too low a temperature, that the receiver should be rather narrow and deep, and, lastly, that the orifice in the vein should be large enough to furnish at least two ounces of fluid in a minute. To effect this, the incision should be about a line and a half in length, and the blood should run in a full and continuous jet.

When the middle of the buffy coat is depressed, or scooped out, as it were, it is said to be *cupped*, — an appearance which is very common in nearly all diseases of a highly inflammatory character, such as pleurisy, peritonitis, rheumatism, and gout. Venous blood is not alone susceptible of being buffed and cupped: the same phenomena are observed in arterial blood, and the only reason, perhaps, why they are not so familiar to us is owing to the less frequent performance of arteriotomy than of venesection. The manner in which this cupped condition of the blood disappears, is well exemplified in a case which came under the notice of my friend, Dr. Charles Woodward, of this city, a few years ago. He attended a married lady under a violent attack of pleuritis, for which she was several times bled: the blood which was taken on the first day of the treatment, was deeply buffed and cupped. Twenty-four hours after, the same appearances were exhibited, except that the clot was not quite so much depressed in the centre; in twelve hours more, the fluid was still buffed, but no longer cupped; and, at the fourth operation, performed three days after the first, it was neither buffed nor cupped.

This cupped state of the blood, as has been just hinted, is generally indicative of the highest degree of inflammatory action, yet, strange as it may seem, it is not unfrequently found in very opposite conditions of the system, as in persons who are greatly exhausted by hemorrhagic and other profuse discharges, and who do not evince the slightest symptoms of phlegmasial excitement. Most commonly, it occurs in connection with inflammation of the serous membranes and the parenchymatous organs; being seldom present in the mucous and dermoid textures.

Although it is not consistent with the plan of this work to enter upon any therapeutic considerations, yet I cannot dismiss this branch of our subject without briefly inquiring how far the buffy coat should be regarded as an index to the abstraction of blood. We have already seen that this phenomenon occurs under very opposite states of the system,

in the most debilitated as well as in the most robust, in the highest degrees of disease as well as in the lowest, and in individuals who are in the enjoyment, apparently, of the most perfect health. The blood, in the advanced stages of pregnancy, is almost always covered with a layer of fibrin; and the same thing is generally observed in persons that have suffered from profuse hemorrhages of the stomach, lungs, or other organs. In individuals subjected to a course of mercury, the blood drawn from the arm is frequently as much buffed as in the most violent attacks of gout or pleurisy, notwithstanding the great reduction of the vital powers. The same effect may be produced simply by taking severe exercise. Thus, if a horse be bled immediately after a smart gallop, while the circulation is carried on with great vigor, the blood will exhibit the buffy coat, whereas that previously abstracted will be perfectly free from it.* Similar appearances have been repeatedly witnessed in the human subject. If these circumstances be coupled with the fact, that the buffy coat may be entirely absent, even in the most intense inflammation, the conclusion is obvious, that the phenomenon in question can neither be regarded as a certain test of morbid action either in the solids or in the vital fluid, nor a safe index of the propriety of blood-letting.

The fibrin is sometimes remarkably destitute of coagulating power. This is strikingly evinced in persons who are suddenly destroyed by lightning and electricity; a violent blow on the stomach, or severe injury of the brain; by the bite of venomous serpents; by acid vegetable poisons, such as prussic acid; excessive fatigue, as in hunting down wild animals; and even violent agitation of the mind. It is also frequently witnessed in Asiatic cholera, in scurvy, and in malignant fevers. Occasionally, too, it is present, and yet the individual is apparently in the enjoyment of good health. Under such circumstances, the most trifling injury may prove fatal, since the only means by which hemorrhage can be successfully combated is taken away, the blood refusing, in spite of all our efforts, to coagulate. Mr. Wardrop, of England, in a short but valuable treatise on blood-letting, published a few years ago, has cited a number of cases of this kind, several of which came under his own immediate ob-

* Cyclopaedia of Anatomy and Physiology, part v. p. 420. The article on the morbid conditions of the blood in this work is from the able pen of Dr. Babington, of London.

servation. In one of the instances alluded to, the patient died from hemorrhage, induced by the introduction of a seton in the side; in another, from a slight wound of one of the fingers; in a third, from the extraction of a tooth; in the fourth, from a superficial wound in the palm of the hand; and, in the fifth, from a bite of the tongue.

An instructive case in which this deficiency in the coagulating power of the blood existed, and became a source of fatal hemorrhage, was recently communicated to me by Dr. Charles Barnes, of this city. It occurred in a servant girl, fifteen years old, of a delicate constitution, who had never menstruated, and had been in bad health for about four months previously to her death. During the last six weeks, she had been taking a variety of the most powerful emenagogues, without any apparent benefit. In this state of things, Dr. Barnes was requested to extract the second molar tooth on each side of the lower jaw. Five days after the operation, the patient was attacked with profuse hemorrhage from the wounded sockets and surrounding structures, which persisted, notwithstanding the employment of the most energetic measures, until in a short time she died perfectly exhausted. In compressing the parts with a piece of cork, the bleeding could be temporarily arrested, but the blood would soon ooze out from the mucous membrane of the cheek.

Mr. Wardrop gives a curious case in which this peculiarity was hereditary. The patient was a boy, and the hemorrhagic tendency displayed itself when he was scarcely two months old. On several occasions, he nearly lost his life from the most insignificant wounds. His brother, twenty-two years old, was frequently afflicted in the same way. Of his five uncles, not one was free from this predisposition: three died after a division of the *frænum* of the tongue, one from the extraction of a tooth, and the other, although he suffered from the same disease, finally died from some other cause. His two aunts exhibited no signs of this diathesis; but, what is singular, all the male branches of their families, excepting one, were thus affected.

A still more remarkable case has been recently reported by Dr. Hughes, of the state of Kentucky. The predisposition here was associated with a rheumatic diathesis, and was satisfactorily traced as far back as five generations. It was confined exclusively to the male branches of the different families; but the females, nevertheless, invariably transmitted

it to their offspring. Many of the individuals died in infancy and childhood,—death resulting in some from the cut of the lancet; in some from accidental wounds; in some from internal hemorrhage; and two simply from the application of blisters, the vesicles being filled with blood instead of water.*

To what is this want of coagulating property of the blood to be ascribed? That it is owing, at least in part, to the insufficient supply of nervous influence, upon the presence of which the vitality of the fluid in question essentially depends, cannot, I think, be denied. The matter, indeed, may be considered as reducible to a syllogism that contains its own proof. The direct influence of the nervous system on the blood was long ago contended for by Barthez and other physiologists, and has been happily elucidated in our own time, by the researches of Dupuytren, Brodie, Dupuy, Thackrah, Cooper, and Meyer, with a host of others of minor character. The latter experimentalist ascertained that, whenever both pneumo-gastric nerves are tied in animals, the blood soon coagulates in the whole pulmonary circle, the coloring matter at the same time separating from the fibrin. Sir Astley Cooper, on repeating this operation, observed similar results; that is to say, the sanguineous fluid was of a semi-concrete consistence, of a dark modena color, even in the arteries, and the lungs were so much loaded with it as to be twice as heavy as in the normal state. Simple division of these cords does not appear to give rise to any such effects, for the reason, probably, that it does not produce any serious obstacle to the transmission of the nervous current. Dupuy, it is true, declares, that he has seen the blood entirely dissolved under these circumstances, and that, upon being infused into the jugular vein of a sound animal, it produced mortification; but I am not able to say, being obliged to quote from Andral, whose statement is very unsatisfactory, whether all this was the result merely of the simple division of the pneumo-gastric nerves, or, as seems most likely, of the removal of a small section of them.

The influence of the nervous system, however, is nowhere more strikingly evinced than in the effects produced by a severe blow on the cœliac ganglion. Here death is caused by the same rapidity as by lightning and the most subtle poisons;

* Transylvania Journal of Medicine, vol. v. For a similar case, related by the same gentleman, see Op. cit. vol. iv. p. 518.

and the blood, as was before stated, exhibits precisely similar appearances, being unusually black, dissolved, and incapable of separating into serum and crassamentum.

I shall only further illustrate this interesting branch of our inquiry by a passing notice of the relative quantity of fibrin contained in healthy and diseased blood. Upon this subject, the late Mr. Thackrah, of England, made numerous experiments, from which he deduced the conclusion that there is always a great redundancy of this substance in inflammatory disorders, even when there is an entire absence of the buffy coat. Sir Charles Scudamore has more recently confirmed these facts, and Mr. Jennings has verified his results,* so that the question must be considered as finally settled. The increase, in most of the experiments performed by these physicians, was about two thirds above the normal standard ; and it would appear that it is proportionably greater in gouty and rheumatic affections than in any other maladies.

It has been supposed that the tying of the pneumo-gastric nerves in the neck has the effect of diminishing the quantity of fibrin in a very notable manner. Professor Dupuy, of the Veterinary School at Alfort, in France, having performed this operation, drew a certain amount of blood from the carotid artery, and ascertained that it contained twenty-one grains of fibrin. In a few hours after, the same amount contained only nineteen grains ; at the end of sixteen hours, eighteen grains ; and, at the end forty hours, twelve grains. In a little more than two days from the operation, the horse died in a state of asphyxia, when the same quantity of fluid, still taken from the carotid, had only seven grains of fibrin.† The question naturally presents itself, — was the progressive diminution, here spoken of, directly produced by the division of the pneumo-gastric nerves, or indirectly by disturbing the process of sanguification ? In all probability the section of the nerve had nothing to do with it ; for it is not at all unlikely, though this is not stated, that the animal at each bleeding lost more blood than was necessary for the purposes of the experiment ; and, if this be admitted, the facts observed by Dupuy, though he accounted for them in a very different way, will be found to tally with the results of the experiments of Dr. Andrews, alluded to in another part of this chapter.

* Transactions of the Provincial Medical Association for 1834.

† Andral, Anat. Path. t. i. p. 201.

The *hematosine*, the second constituent of the crassamentum, is no doubt often altered in disease; but what these changes are, or with what states of the fluids or solids they are connected, has not yet been determined. In many maladies, it seems to disentangle itself from the globules in which it naturally resides, and to percolate through the vessels into the different cavities of the body, or into the interstices of some of the organs. This disengagement frequently occurs in sea-scurvy, in malignant dysentery, and in typhous fever, and is the cause, in all likelihood, of the passive hemorrhage, and petechial spots which are so commonly met with in these affections. To the same circumstance is to be attributed the stained condition of the endocardium and the inner membrane of the vessels, which usually takes place within a short time after death, especially in warm weather, and which has sometimes been mistaken for the effects of inflammation.

The *hematosine* often exists very sparingly. This diminution, as might be anticipated from its apparent cause, is usually connected with those conditions of the system which are characterized by great debility, whether occasioned by impoverished living, protracted indisposition, or profuse hemorrhagic discharges. It is very constantly met with in chlorosis, in ascites, in organic affections of the stomach, and duodenum, in persons who are frequently bled, and in females who suffer habitually from menorrhagia. As having a direct bearing on this subject, it may be stated that women have always, comparatively speaking, less *hematosine* in their blood than men,—a fact which was first ascertained, I believe, by Lecanu, and which, he thinks, is attributable to their monthly evacuations. The following comparative view is the mean of his analysis made with blood drawn from ten adults of both sexes:

	Female.	Male.
Water,	804.37	789.32
Albumen,	69.72	67.50
Saline and extractive matter,	9.95	10.69
Red globules,	115.96	132.49
	1000.00	1000.00

In the above diseases, the countenance is remarkably blanched from the want of *hematosine*, the different tissues are literally exsanguineous, the nutritive function is badly executed, and there is great failure of the strength, with a dis-

position, in many cases, to cellular infiltration of the extremities. This state of things often persists for months, and, occasionally, as in chlorosis, even for years,—a fact strongly illustrative of the tardy reproduction of the hematosine on which it depends. The blood, under such circumstances, is absolutely impoverished, being scarcely fit for the purposes which nature has assigned to it, from the absence of fibrin and red particles. Acute maladies produce, in effect, the same results, with this difference, that these two important elements of the vital fluid are usually much more quickly regenerated, especially when the individual has the benefit of free exercise, and animal food.

There are some maladies, such as cholera, typhus, and plague, in which the hematosine is unusually black. The reason of this has not yet been determined. By some it has been attributed to a diseased state of the blood, by which it is rendered unfit for being duly arterialized by exposure to the atmosphere. Such, amongst others, is the opinion of Dr. Thomson, of Europe, which, however, is directly at variance with that of Dr. O'Shaughnessy, who maintains, and I believe correctly, that cholera blood is not only capable of absorbing oxygen, but also that it emits carbonic acid gas. Dr. Stevens, on the other hand, supposes that the black color is directly ascribable to the contaminating influence of the contagious virus of this disease, whereby the circulating fluids are changed in their character, at the same time that they suffer a great loss of saline matter. These views are neither of them, it seems to me, entitled to much respect, as not one of them, with the exception, perhaps, of the latter, is supported by positive fact. In the production of the appearance under consideration, we may suppose that the combined agency of several causes is necessary. Amongst these, the most important, without doubt, is the partial abstraction of the vital properties of the blood, producing thereby a general impairment of the various functions of the system. In no organ is this disordered action carried to so great a degree as in the lungs, where, although the atmosphere still comes in contact with the delicate air-cells, the sanguineous fluid, from its exhausted condition, and destitution of saline principles, is no longer susceptible of being properly arterialized. That this is true, is abundantly established by pathological anatomy, physiological experiments, and chemical analysis; for, as will be seen hereafter, the blood, in the diseases referred to, is generally

extremely black, dissolved, highly carbonized, and sometimes almost entirely drained of its salts. In cholera especially, these states of the blood are amongst the most uniform occurrences; and it is to them that are to be mainly attributed the livid color of the skin, the embarrassed breathing, and the rapid exhaustion which those who are the subjects of the malady generally exhibit.

To this general statement several other facts, strongly corroborative of what we have said, may now be added. In the first place, we may notice the effects that result from a division of the pneumo-gastric nerves, which are the governors, if I may use the expression, of the respiratory organs. This experiment is invariably followed by a suspension of the arterializing process, in consequence of which the blood is always found of a black color after death, both in the veins and in the arteries. The same effect has been observed by Sir Astley Cooper to be produced by merely tying these nerves. The blood also, he states, flows of a dark color when the carotid artery is opened after the phrenic nerves have been secured: the lungs, in this case, are not found heavy and engorged, as in the former. These researches, together with many others of a similar character, that might be cited, clearly demonstrate the dependency of the arterializing process upon the nervous influence. Take this agent away, and the vital fluid becomes darker and darker, until at length the lungs are utterly incompetent to make any salutary impression upon it.

These changes, secondly, are generally produced more rapidly in proportion to the abstraction of the salts of the blood. The truth of this remark is strikingly corroborated by what occurs when we inject saline fluids into the veins of cholera patients,—an operation which was performed successfully in several instances, both in this country and in Europe, during the prevalence of this disease. In the collapsed stage of this disease, when the individual is actually in a state of asphyxia, the skin cold and livid, the respiration labored, and the pulse imperceptible at the wrist, no sooner are the watery and saline materials restored than the whole aspect of things is changed; the heart begins to act with increased vigor, warmth is diffused throughout the body, the breathing becomes easier, the strength returns, and the surface recovers its accustomed hue. Blood drawn from the arm, under these circumstances, will exhibit, if not its usual appearance, a very close approximation to it. Thus, then, there are at least two elements con-

cerned in the production of the black color of the hematosine, — a partial abstraction of the vital principle, and a diminished amount of saline matter. Whether these are the only ones, I cannot pretend to decide ; nor can we expect to be able to remove the veil which still enshrouds the subject, until animal chemistry shall make the discoveries, and reveal to us the true nature of hematosine, its mode or origin, and the manner in which it is combined with the other principles of the blood. Until this be effected, no speculation on the part of the morbid anatomist, however refined or ingenious, can be entitled to any sort of confidence, or throw any real and substantial light upon his profession.

The *serum*, like the *cruor* with which it is so intimately combined, is liable to various alterations, carried to such a degree, frequently, as to entitle them to be termed morbid. Thus it has been found to have the aspect and consistence of milk ; to have streaks upon its surface like cream ; to have oil in it ; and, finally, to be remarkably destitute of saline and animal principles. These changes may occur exclusively in the serum ; but, in the great majority of instances, there is reason to believe that the fibrin and hematosine participate in them.

The occurrence of *milky serum* is not so uncommon, I am disposed to think, as the silence of the profession, in regard to it would lead us to infer. Morgagni relates two cases of malignant fever, in which he noticed this appearance : Mr. Hewson also mentions several examples of it ; and, since his time, numerous instances have been recorded by other writers. This state of the serum is usually met with in inflammatory disorders, and seems to be connected, in some way or other, with deficient assimilating power of the digestive organs. In a case of milky serum, which fell under my observation in 1832, the patient, a young man, thirty years of age, had long been addicted to the intemperate use of ardent spirits, and at the time here specified, he labored under symptoms of pleuritis, accompanied with headache, want of appetite, and considerable constitutional disturbance. The blood, as it issued from the vein in the arm, had a singularly dirty, turbid appearance, not unlike a mixture of chocolate and milk. It had scarcely been drawn ten minutes before it began to assume a white creamy aspect ; and it finally formed a layer on the surface of the clot about the eighth of an inch in thickness. In the course of an hour, some of this fluid was skimmed off, and put in another vessel, in which it was allowed to remain dur-

ing a period of half a day. On examining it, at the expiration of this time, I found it to be slightly concrete, of the specific gravity of 1.026, remarkably unctuous, and of a strong saline taste. It readily coagulated, on the addition of alcohol, corrosive sublimate, and the mineral acids, as well as on exposure to heat; and, on being viewed with the microscope, exhibited no appearance whatever of globules,—circumstances which justify the conclusion that it was essentially composed of albumen. The cruor in this case was somewhat more abundant than usual, and the quantity of serum of course less. It is worthy of remark, that, upon a repetition of the bleeding, twenty-four hours afterwards, the blood presented precisely the same characters as before.

Milky serum, as might be expected, always contains an inordinate amount of adipous matter. In a specimen examined by Laennec, 1000 parts were found to consist of 794 of water; 65 of albumen; 108 of fatty matter, cholesterine, and acid soap; 17 of elaine, margarine, and stearine; and 25 of saline and extractive substances. The fibrin and hematosine had nearly entirely disappeared; and, in place of the globules, there was a large quantity of fatty matter, which was suspended in the serum, and gave the fluid its characteristic milky aspect. Similar results have been obtained by Christison, Babington, and other writers.

To the same class of cases ought to be referred, I apprehend, those in which the serum is said to have contained *oil*, of which several well-marked examples have been recorded by Dr. Traill, of Liverpool, in the twenty-fourth volume of the Edinburgh Medical and Surgical Journal. In the last specimen which he has described, the serum was of a light straw-color, cream-like in its consistence, and at first apparently homogeneous. On being kept, however, for a short time it coagulated, and was poured with difficulty from the bottle in which it was contained. On analysis, it yielded a large proportion of albumen and oil, the latter of which was so pure as almost to burn when exposed to the flame of a lamp.

It has been made a matter of inquiry to ascertain, if possible, the cause of this milky state of the serum. On this subject, however, there is no positive testimony. By some it has been attributed to the admixture of fatty matter; by others, among whom may be mentioned Haller, to the presence of crude chyle. That it is connected with deficient assimilat-

ing power appears altogether probable, both from the nature of the diseases in which this peculiar state of the serum is found, and from the resemblance which this substance bears to the fluid just referred to. Chyle, it is well known, varies in appearance as the food has or has not contained fatty matter: in the former case, its color is milk-white; in the latter, it is nearly transparent. Soon after being drawn, it coagulates, and subsequently separates into three parts,—one solid, which rests at the bottom of the vessel, and looks like fibrin; another liquid, which is analogous to serum; and a third, which forms a thin layer on the surface of the others, and is of an oily nature. If to this remarkable similarity between these two fluids we add the fact, that nearly all the cases in which milky serum has been observed were characterized by derangement of the chylopoietic viscera, it renders it more than probable, I think, that the appearance under consideration is owing to deficient assimilation, by which a larger amount of fatty substance is retained in the circulation than in the normal state. Where the fault actually resides, whether in the mesenteric glands, in the thoracic duct, or in the lungs, or in all these organs, is a question which, in the present state of the science, it is impossible to determine. Future observations, cautiously and patiently conducted, will alone be adequate to solve the problem.

It is seldom that we find this state of the blood associated with the buffy coat. I know of but one case of the kind, which is reported in a late number of the London Medico-Chirurgical Review.* It occurred in an intemperate man, forty-seven years old, who was bled for pneumonitis, attended with high febrile excitement; the crassamentum was coated with a thick layer of fibrin, and the serum exhibited not only a milky aspect, but likewise a milky odor. The urine, too, had a similar appearance, and was sparingly secreted.

It has been long a matter of observation, that, in high degrees of inflammations, the watery part of the blood is more, viscid, and of a deeper yellowish color than usual, presenting frequently, the aspect and consistence of synovial liquor. This appearance is less evident when the clot does not float in, or occupy the centre of the fluid. Gendrin has shown that the serum, in these disordered states of the system, contains at least twice as much albumen as in the healthy state,—a cir-

* No. 63, p. 229.

cumstance which readily accounts for its remarkable viscosity, its astonishing coagulable properties, its increased specific gravity, and its deep yellowish color.

In dropsical and cachetic persons, on the contrary, the serum is generally much thinner, and of a paler hue, than in such as are favored with an opposite state of the system. Its specific gravity is also much less, and there is a sensible diminution of albumen. Similar alterations take place in persons who are in the habit of being frequently bled. The effects thus produced, though long known, have been placed in a very striking light by the recent researches of Dr. Andrews, of England.* The animal selected for the experiments was the calf, which was bled from a large orifice in the jugular vein, till symptoms of syncope were induced. The operation was repeated at intervals of twenty-four hours, during which the calf was generally once fed upon a mixture of meal and water. The appearance of the blood thus drawn was greatly altered at each successive abstraction. At the first operation, the *cruor* was very large, and a considerable portion of *hematosine* was collected from it; but, as the *venesection* was repeated, it gradually diminished in bulk, whilst its consistency augmented till the fourth bleeding, when it presented the appearance of a small contracted ball immersed in a great quantity of serum.

This experiment was frequently repeated on different animals, and uniformly with the same results; whence it may be fairly inferred that an increase of serum, with a corresponding diminution of *crassamentum*, is a very constant if not an invariable effect of the repeated abstraction of this fluid from the system. Dr. Andrews further ascertained that there is a perceptible decrease of albumen and salts at each bleeding; he states, however, that the diminution is very variable, and that it seldom exceeds one and a half per cent. even after the fourth operation. In the globules a still greater diminution occurs, being not unfrequently reduced to less than one half their original number. These experiments are unquestionably of a highly interesting nature, and their results are well calculated to lead to useful precepts in practice.

Organic disease of the kidney is another of those conditions in which there is a deficiency of albumen with a consequent diminution of specific gravity. The reason of this

* London Medical Gazette, vol. xv. p. 592.

is obvious. In nearly all cases of this disorder, the serum is deprived of its animal principles, and the urine, which is loaded with them, is readily coagulable by heat, alcohol, and acids. Dr. Barlow, of London, who has devoted much attention to the examination of the blood and urine in organic disease of the kidney, ascertained that the specific gravity of the serum is sometimes as low as 1.013, and seldom higher than 1.020. These results coincide with those of Dr. Babington, who states that, in what the French have called "Bright's disease," he has invariably found this fluid much below the healthy standard. In a case of this kind, there was nearly one eighth as much albumen in the urine as in the serum, and the patient lost as much of this constituent daily as if he had been bled to the extent of four ounces.* In cholera, on the other hand, the watery portion of the blood being drained off, the serum which remains is of high specific gravity, and contains nearly double the ordinary proportion of albumen. Jaundice, as was long ago observed by John Hunter, is another disease in which this fluid is morbidly affected. In this condition of the system, it is not unusual, indeed, to find the serum, as well as the urine, of a deep orange color.

How far, or in what respects, the saline ingredients of the serum are liable to be altered, are points concerning which we have no accurate information. That they frequently exist, in excess as well as in defect, does not admit of a reasonable doubt. The ill effects resulting from the long-continued use of salt provisions are familiar to every army and navy surgeon. Inflammatory fever, irritable ulcers, itch, and tetter, with other highly distressing and troublesome disorders, are often directly chargeable to such a mode of life. On the other hand, in scurvy, Asiatic cholera, and in the malignant fever of tropical climates, it is extremely probable, as has been observed by Dr. Stevens, O'Shaughnessy, and others, that there is generally a great deficiency of saline ingredients. In these disorders, the hematosine remains dark even in an atmosphere of pure oxygen; but, on the addition of a solution of muriate of soda, instantly assumes a florid hue; and this is said to take place even when the solution is very weak. Frequent bleeding, as we have already seen, has also the effect of sensibly diminishing the saline matter of the blood.

* Cyclopaedia of Anatomy and Physiology, part v. p. 426.

On the whole, it must be confessed that our knowledge concerning this subject is extremely meagre and imperfect, and numerous researches and chemical experiments will have to be made before we can hope to arrive at any satisfactory or useful results.

That the blood, considered as a mass, may be variously affected, is equally true as of its several constituents. All such changes, whatever they may be, should be carefully studied, as they correspond with so many particular morbid states of the system. Professor Andral has cited numerous cases in which the blood not only contained the different elements of the secreted fluids, but likewise a variety of other accidental products, such as pus, entozoa, and encephaloïd matter. In whatever way these substances may gain admission into the vessels, or in whatever mode they may be there developed — and concerning which I do not feel disposed here to speculate — certain it is, that, by combining with the blood, they not only vitiate it, but sometimes completely alter its physical, chemical, and vital properties. From the recent observations of some of the English and French anatomists, little doubt can be entertained that the elements of what are termed the heterologous formations, have their origin in the circulation, and that they are deposited subsequently in the various organs and textures, like other substances, by a sort of perverted action, induced by their presence.

The ill effects of contaminated blood on the solids are well illustrated in the operation of transfusion. This operation, which was invented by Lower, in 1665, consists in transferring the blood of one animal into the veins of another, and has recently been performed, with complete success, by several European practitioners. That no detriment, however, may accrue from this source, it is absolutely necessary that the fluid thus used should be of a healthy character, otherwise it will invariably act as a poison. Of the truth of this assertion there can be no reasonable doubt, as it has been fully established by experiments on the inferior animals, to say nothing of the innumerable instances in which this effect has been witnessed in the human subject. The first case I shall refer to is one recorded by Dr. Gendrin, of Paris, a gentleman of acknowledged veracity, great talents, extraordinary professional attainments, and well known as the author of several admirable treatises in medicine and morbid anatomy. A man, a player by occupation, was affected with putrid fe-

ver, attended with excessive prostration of strength, gangrenous pustules, and hemorrhagic exudations from the mouth and nostrils. His breath, faecal discharges, and, in fact, his whole body, exhaled a most offensive odor; and the blood which was taken from the arm was unusually black, scarcely coagulated, and displayed a remarkable tendency to decomposition, being already quite fetid at the end of three hours and a half. Under these circumstances the vein was reopened, and an ounce of blood being drawn, it was introduced into the cellular tissue of the groin of a cat. The animal was soon seized with copious vomiting, followed by dyspnoea, thirst, and extreme prostration, and, in less than seven hours, it expired in convulsions. On inspection, the different viscera were found in a state of congestion and ecchymosis; the heart was soft and flabby; the blood was every where black and uncoagulated; the left pleuritic sac contained several ounces of sero-sanguinolent fluid; and the whole body emitted a nasty, fetid odor, and speedily began to putrefy. A small quantity of blood, taken from the same patient, was next injected into the femoral vein of a dog. Similar phenomena ensued as in the preceding case; the animal soon died from the effects of the morbid fluid. The same distinguished writer details some experiments which he performed with the blood of persons affected with confluent small-pox. In a very short time the most violent effects arose, and the dogs, the subjects of the investigations, usually died in from twenty to thirty hours, in consequence, apparently, of inflammation of the principal internal viscera. On repeating this experiment, some years ago, upon a cat, no unpleasant effects followed; from which it may be inferred that this sort of blood does not always possess noxious properties.

To these experiments may be annexed the extraordinary case related by Du Hamel, of a butcher, who died of malignant pustule, four days after having held in his mouth the knife with which he had slaughtered an over-driven ox. Another person lost his life by accidentally pricking his hand with a bone of the same animal; and two women suffered severely merely from some drops of blood falling on them.

Not less conclusive are the results of the experiments of Dupuy and Luret. These physiologists assure us that, on introducing blood, taken from a horse affected with malignant carbuncle, into the veins and cellular tissue of another, they have frequently succeeded in inducing the disease. In like manner,

glanders have been communicated by Professor Coleman, of London ; and we are informed, by Dr. Hertrizch, of Berlin, that hydrophobia can be readily produced by inoculating a sound animal with the blood of one that is rabid. A peculiar disease of the dog, called mange, has been transferred in the same way. These facts are highly interesting, inasmuch as they throw light on another subject, namely, the propagation of exanthematous affections by artificial means.

As the blood, in the examples above quoted, was capable of transmitting similar affections, no doubt can be entertained that it was really contaminated ; and there is, moreover, the strongest ground for believing that fatal disturbance is often induced in this way, where we are little prepared to expect it, for aught we can discover in this fluid. The experiments, indeed, of Dr. Christison, Dr. Coindet, and others, of injecting poisonous substances into the veins of animals, conclusively show that, although the smallest quantity will frequently destroy life, yet the most delicate chemical tests will be insufficient to detect their presence in the vital current.

Inordinate acceleration of the circulation appears to be often followed by serious alterations of the blood. It was long ago remarked by Haller—and the observation has been repeatedly made by others—that violent muscular exertion will vitiate this fluid, render the perspiration strong and offensive, change the qualities of the urine, and terminate, if long continued, in intense fever, and even death. Dupuy, of France, has ascertained by experiments that the fibrin is either very sensibly diminished or otherwise altered, in animals that are subjected to excessive exercise ; and the celebrated Chaussier assures us, that the transfusion of the blood, under such circumstances, will be speedily followed by the developement of gangrenous pustules and malignant fever. The deleterious effect on the blood produced by over-driving animals is well illustrated by the case narrated by Du Hamel, detailed in a preceding paragraph, and is still further exhibited in an instance which occurred in our own country. The case to which I refer is this: A few years ago, a number of fattened cattle were driven into one of the New England cities, and, having been pressed too hard in a sultry day, were so overheated, that some of them became quite exhausted. In this condition they were slaughtered, and the consequence was, as is stated by the reporter of the case, Dr.

Fountain,* that nearly all who partook of their flesh were seized with typhous fever.

In Asiatic cholera, again, in fevers, and other maladies, the blood, contemplated as a mass, is very materially altered; but whether primarily or consequentially, is a question by no means decided. In the first of these singular disorders, the fluid is drained of its water, and consequently contains a disproportionate amount of albumen, fibrin, and hematosine; its color is excessively black, both in the veins and in the arteries; it coagulates very imperfectly; is greatly augmented in specific gravity; and the saline matter occasionally wholly disappears. One of the most extraordinary circumstances connected with the blood of cholera subjects, is the presence of urea; this substance, however, is not always found, and, according to Dr. O'Shaughnessy, it is usually most abundant where there is marked and long-continued suppression of urine.

The great diminution of the serum of cholera blood is easily accounted for by the rice-fluid discharges, which are often so excessively copious in this disease, and which are essentially composed of the same elementary principles, namely, water, animal matter, and neutral salts. According to the analysis of Leeau, the most elaborate that has yet been furnished, it contains neither caseum, nor bile, nor albumen, except in the form of flakes suspended in the ejected liquor.

The blood of fever patients has recently begun to attract a considerable share of attention among practical writers; but as yet our knowledge in relation to this subject is both limited and imperfect. In those who died of typhus at Brest, in 1757, the blood is said to have been grumous, black, and decomposed, particularly in the portal vessels; and Dr. Tweedie, in his "Clinical Illustrations of Fever," states that the coagulum of the blood in this class of diseases, instead of forming a firm coagulum, is unusually soft, scarcely of the consistency of half-boiled currant jelly, preternaturally small, and so destitute of cohesive power as to break on the slightest touch. Similar phenomena have been noticed by Dr. Gerhard, in the blood of typhous fever patients in the Philadelphia Alms-house Infirmary, to which he is a physician.

* Transactions of the Medical Society of the State of New York, vol. iii. p. 219. Albany, 1837.

In the *yellow fever* of Philadelphia, in 1797, Dr. Rush found the blood frequently quite dissolved, dark, grumous, and occasionally like the washings of flesh. In some of the cases, the serum had a yellow color; and, towards the close of the disease, it was very common to see the cruor more or less sity. This appearance, it would seem, generally portended a favorable issue.* Similar states of the blood have been noticed by Ariquila, Bally, Palloni, and others, in the epidemic yellow fever of Spain; and, more recently, by Dr. Copland and Dr. Stevens, in the same disease, as it occurred in the West Indies. These authors describe the blood of yellow fever patients as semi-concrete, of a dark color, very poor in regard to its fibrous and saline constituents, and extremely prone to decomposition. A state very analogous to this is observed in the plague, in epidemic peritonitis, and in the worst forms of erysipelas.

The blood frequently experiences great changes in *chlorosis*, both as it regards its color, its consistence, and the relative proportion of its ingredients. It is almost always remarkably impoverished, and it is to this circumstance that is to be ascribed the blanched appearance of the skin, with the diminished temperature which form such prominent features in its history. In the violent degrees of this malady, the crassamentum is soft and small, the serum thin and copious, and the hematosine so pale as scarcely to leave a stain when dropped on white linen. From an examination of two specimens of chlorotic blood, by Mr. Jenkins, of England, it would appear that the albumen and salts exist in the usual proportions, that there is a considerable increase of water, and a very great diminution of coloring matter, to the amount nearly of two fifths.

Jaundice is another disease, in which, as was formerly stated, the blood is more or less altered in its properties. Not only the coloring principle of the bile, but even the resin of this substance has been detected in the circulation; and, as a necessary consequence, especially when the disease is of long continuance, every tissue of the body assumes a yellowish tinge, as well as, in many cases, the different secretions. In four subjects that I have had occasion to dissect within the last five years, all the soft parts, together with the whole of

* Medical Inquiries, vol. ii. p. 13.

the osseous and cartilaginous systems, were of a deep orange complexion, from this cause. Even the brain participated in the change ; for its substance was by no means of so clear a white as in the healthy state. When the bile is thus introduced into the general circulation, it appears to act as a sort of narcotic, inducing drowsiness and irritability. In other cases it generates fever, with headache, nausea, and loss of appetite. It should be observed, that the presence of this fluid may be easily detected in the serum of the blood by adding to it an equal quantity of sulphuric acid, diluted with twice its bulk of water. The serum, as has been stated by Dr. Babington, will thus change its yellow straw-color for the characteristic green tint of bile.

But in no deranged condition of the body is the blood more remarkably altered than in *scurvy*. This fact, although long ago noticed by physicians, appears to have been first placed in its true light by Dr. Mead, of Dublin. In his medical works, published in 1767, it is distinctly announced that the blood of persons laboring under this disorder is always unnaturally black, greatly deficient in cohesive power, and manifesting no disposition whatever to separate into serum and crassamentum. In the latter stages of the malady, the fluid had the aspect and consistence frequently of thin tar, treacle, or even of ink, the fibrin looking like wool floating in a dark, muddy substance, sometimes of a greenish tint. The blood that oozed from the mucous surfaces, in the form of spontaneous hemorrhage, exhibited similar appearances, thus showing, most conclusively, that it had undergone essential changes, both in its chemical properties and in its vital affinities.

To the instances now cited, numerous others might be added, equally striking and satisfactory, in which the vital fluid is most seriously altered, and transformed into a substance very different in its character from that observable in the healthy state of the economy. But to do this would far transcend the limits of the present work, and would be literally writing a treatise on individual maladies, — a task which I do not feel disposed, even if this were the proper place, to undertake. From the facts that have been presented on this interesting subject, it cannot be doubted, I think, by any one who duly and impartially contemplates it, that the blood is a fruitful source of disease, or, in other words, that it is suscep-

tible of various morbid impressions, of which, in many instances, it is the primary and original seat. Considering the vast surface from which the chyliferous vessels imbibe the nutritious matter, and the heterogeneous nature of our food and drink, it is highly probable that the elements of disease may thus readily find their way into the current of the circulation, and establish a prejudicial action in the solids, by which they in turn are disordered, and thrown into commotions incompatible with the harmony and well-being of the general system or of some of its numerous members, tied together as they all are, figuratively speaking, by the closest consanguinity.

CHAPTER II.

Of the Cellular Texture.

Distribution. — Physical Characters. — Organization. — Physiological Properties. — Lesions. — Acute Inflammation. — Suppuration. — Gangrene. — Chronic Inflammation. — Induration. — Serous Infiltration. — Emphysema. — Degenerations. — Foreign Substances. — Guinea Worm.

THERE is no tissue which is so extensively and universally diffused as the cellular. Occurring in every organ of the body, it not only contributes materially to its composition, but serves the more important purpose of cementing together its several anatomical elements, binding them up into one united whole. In quantity it varies very much in different situations, being extremely abundant in some, and almost entirely wanting in others. There is a great deal of it immediately beneath the skin, especially in the axilla and the groin, in the mediastinal cavities, in the abdomen, and in the pelvis. The vessels have likewise a considerable share of it; the lungs are well supplied with it; and a large quantity of it is always found amongst the voluntary muscles. On the other hand, there is very little cellular tissue in the heart, brain, liver, spleen, and kidney; in the uterus, ovary, testicle, and penis;* in the tendons, ligaments, and fibrous membranes. None exists, except in a combined state, in the bones, the cartilages, and the substance of the cerebro-spinal axis.

In regard to its density, this substance likewise presents considerable variation in different regions of the body. Generally speaking, this property may be said to be in direct ratio to the quantity of the tissue, being very slight in those situations which abound in it, and very great wherever there is a scarcity of it. It is very lax beneath the skin, except at the mesial line, and around most of the internal viscera. The same arrangement obtains in the muscles; but, as this sub-

* These remarks are applicable, of course, only to the proper structure of these organs.

stance penetrates into their interior, it becomes gradually more dense, short, and delicate, until it finally escapes observation. Under the skin, the cellular tissue is spread out in the form of a lamella, which can be traced as a continuous whole from one region of the body to the other, and which constitutes what, in surgical language, is denominated a fascia. It may also be stated here that this substance receives different names, according to the organ with which it is associated, as subcutaneous, retro-peritonæal, submucous, inter-muscular, and subserous. The peculiarities which it exhibits in these localities will be pointed out in their proper places.

The cellular texture is highly extensible and elastic, and is thus well qualified to discharge the various functions that have been assigned to it in the animal economy. Another property possessed by it is the hygrometric, by virtue of which it expands and regains its primitive softness and pliancy, when immersed in water after having been dried. It is composed principally of albumen, in union with a little gelatine, the quantity of which is always less in the old than in the young. It resists putrifaction for a long period, and is not easily broken down by boiling. Exposed to destructive analysis, it yields oxygen, hydrogen, carbon, and azote. The cellular substance is every where lubricated by a thin watery fluid, the presence of which is essential to the due exercise of its healthy functions. It is of an albuminous nature, and identical with the serum of the blood, whence it is derived.

Examined in reference to its structure, (Fig. 7,) this tissue is found to be

Fig. 7.



composed of whitish filaments, homogeneous, soft, and transparent, which intersect each other in all directions, forming thereby an infinity of cells which freely communicate together over the entire body. Of the many proofs that might be adduced in illustration of the truths of this position, it will suffice to mention that fluids introduced

at one point can be readily forced to another, however remotely situated. In anasarca, the effused water always gravitates towards the most depending part of the limb, where it may be readily discharged by slightly puncturing the skin. On the same principle, the air in emphysema frequently extends over the whole body, elevating the integuments into a soft, irregular swelling, which emits a peculiar crackling noise on pressure. All these are so many circumstances demonstrating the direct continuity of the cells of the substance in question.

In their shape, the meshes of the cellular substance are too variable to enable us to express any definite opinion respecting it. In some situations, they appear to be of an oval form; in others, they are rounded; in others, cylindrical; in others, angular. In most parts, these figures occur in a state of combination. Equally variable are the dimensions of these cavities. In the normal state, they are quite small, so much so, indeed, that some writers have been induced to deny their existence; but, in certain pathological states, they often acquire a considerable magnitude. The cells can be easily demonstrated by injections of melted glue, or still better by distending them with water, and afterwards exposing the part to a freezing mixture. In this way, numerous icicles will be formed, having the form and volume of the cavities which they occupy.

The filaments of which this tissue consists are variously aggregated in different parts of the body. In the glands, they are arranged into a species of frame-work, into the meshes of which is deposited the substance which imparts to them their characteristic attributes, whilst upon their walls are ramified the vessels and nerves which are required for their support and animation. In the bones, they form a nidus for the reception of earthy matter; in the serous membranes, they present a lamellated disposition, and in the vascular tubes, they are arranged spirally. Thus, these filaments do not merely enter largely into the construction of the various organs, but they actually form the basis of every one of them, no matter what are its essential anatomical elements.

The sensibility of the cellular texture is very obscure in the normal state; but, when inflamed, it is often the seat of severe pain. Nervous filaments penetrate it on every side, but they do not appear to be lost in it, for in general they can be traced to some contiguous organ. The same remark

is applicable to its blood-vessels and absorbents, the former of which are excessively delicate, and do not convey red fluid in the healthy state. It is also said to receive exhalants, but this is a mere conjecture, unsupported by facts.

The absorbing powers of this texture are very great. Fluids of various kinds, so often effused into its meshes, are rapidly taken up, and eliminated by the kidneys, skin, and other outlets. Some articles of the *materia medica*, placed in contact with it, exhibit their specific action in distant organs in as short a period nearly as when introduced into the stomach. A solution of emetic injected into the subcutaneous cellular substance of a dog, speedily induces vomiting, morphia, sleep, and strychnine tetanic spasms.

The cellular substance presents certain peculiarities depending upon age. In infancy, it is extremely delicate, soft, spongy, and transparent; in the adult, it is firm, dense, and somewhat opaque; and, in advanced life, it is remarkably hard, dry, and resisting, not unlike aponeurotic membrane. It likewise loses a considerable share of its elasticity, and hence that withered appearance of the skin which forms so characteristic a trait of old age and decrepitude.

Notwithstanding its apparently unorganized character, the cellular substance possesses the formative power in a very eminent degree. When destroyed, it is speedily regenerated; and, in many instances, it supplies the loss of these textures that cannot be perfectly reproduced, as the muscular and tendinous. Every growth, in fact, whether normal or accidental, begins, there is reason to believe, in the cellular substance.

It has been already stated that the cellular texture is every where continuous, and it may be added, in conclusion, that that of the exterior of the body freely communicates with that of the splanchnic cavities, by certain openings existing at different parts of the body.

The cellular tissue, diffused, as we have just seen, through every part of the body, and cementing together its various anatomical elements, is prone to numerous diseases, both of a primary and consecutive nature. Many of these lesions are of a highly interesting character, as affording an admirable insight into some of the most striking processes employed by the animal economy, in repairing injuries, and in throwing off from the system such materials as have a tendency to impede the exercise of its normal functions. The principal

morbid affections of the cellular tissue, those which demand the special attention of the morbid anatomist, may be comprised under the following heads: 1. acute inflammation, suppuration, and gangrene ; 2. chronic inflammation ; 3. induration ; 4. serous infiltration ; 5. emphysema ; 6. transformations into other substances ; 7. and lastly, the development of insects.

I. In *acute inflammation*, the cellular tissue is of a light reddish color, soft, spongy, and inelastic ; its cavities are filled with an opaque, gelatinous fluid ; and all the vessels ramifying through it are enlarged, and distended with blood. The nerves, too, are increased in their dimensions ; and, when the irritation has been violent, it is not unusual to find small extravasations, produced by a real rupture of some of the capillaries. If the part affected contains much adipous matter, it will be variously modified, according to the degree of the inflammation ; when moderate, the fat is commonly absorbed ; but, if intense, it is broken down, mixed with the effused blood, and converted into a yellowish, pap-like substance, nearly destitute of its original features. These appearances, which denote a high degree of morbid action, always decrease towards the periphery of the inflammation : the redness also gradually declines in intensity ; the vessels are less minutely injected ; and the tissue, although somewhat *œdematous*, preserves its accustomed elasticity and expansibility.

After some time, varying from three to eight days, softening takes place towards the centre of the inflamed mass, and the cells of the tissue become loaded with globules of *pus*. Subsequently the walls of these interstices are broken down, and the purulent matter is collected into one or more cavities. The swelling, in the mean time, becomes more circumscribed, the surrounding *œdema* diminishes, and the neighboring cells being agglutinated together by lymph, an effectual barrier is thus presented to the extension of the *pus*. The cellular substance immediately around the matter is of a dense compact texture, forming a firm, resisting sac, the inner surface of which, at first red and rough, gradually assumes a smooth, velvety aspect, not unlike mucous membrane.

Such are the ordinary characters, and such the usual termination of circumscribed *phlegmonous* inflammation of the cellular tissue. Another variety, much more formidable than the preceding, because much more destructive in its results, is the *diffuse*, so termed from its spreading tendency. In

whatever manner this disease arises, whether from external violence, phlebitis, poisoned wounds, phlegmonous erysipelas, or any other cause, it always attacks a large extent of surface, often invading a whole limb, or even a considerable portion of the trunk. In most cases it terminates in suppuration, and sometimes even in sloughing. The matter, which is generally of an unhealthy, sanguous character, is not contained in a sac, nor is it restrained by an effusion of fibrin, as in the phlegmonous form, but is extensively diffused, and often causes great havoc in the adjacent structures.

When diffuse inflammation occurs in debauched, worn-out individuals, as it is apt to do when it presents itself in the form of a carbuncle, it not unfrequently terminates in *gangrene*. This disease, which is usually located in parts remote from the centre of the circulation, is characterized by a soft, doughy, undefined swelling, with deep-seated, burning pain, an oppressive sense of weight, and vesication of the cuticle. In a short period, the swelling assumes a dark brownish, violet or purple color, and imparts a peculiar, boggy feeling, as if the subjacent textures were floating in a fluid. Numerous apertures now appear in different parts of the skin, giving vent to a thin, acrid savies. If the cellular substance thus affected be examined after death, it will be found to have the appearance very much of wet tow, being of a deep ash-color, soft, inelastic, extensively detached, and bathed in a bloody and highly offensive fluid. These changes are not always confined to the subcutaneous cellular tissue, in which they more commonly commence. Not unfrequently, long, sinuous tracts are formed between the muscles, and gangrenous shreds are seen hanging from aponeurotic sheaths, tendons, ligaments, and blood-vessels. Sometimes, though rarely, the disorganizing process extends to the periosteum, involving it and the subjacent bone in the destruction. Excessive pain and great constitutional disturbance — at first of an inflammatory, and afterwards of a typhoid character — are the usual attendants of this formidable malady.

II. In *chronic inflammation*, the cellular tissue no longer tears with the same facility as in health: it is dense and hard, so as to crisp when cut; and, although it admits of slight extension, it is nearly destitute of elasticity. When the disease is protracted, the tissue gradually assumes an opaque, milky color, and its cavities are distended with sero-fibrinous matter, so as to be no longer permeable to blood,

air, pus, or water. These alterations, which give the seat of the disease a tumid and constricted feature, are well characterized in the callous edges of old ulcers, in chronic erysipelas, in the hard swellings so often witnessed in gouty and rheumatic affections, in pelagra, elephantiasis, and in the induration of the cellular substance of new-born infants.

This disease seldom produces healthy pus; on the contrary, the matter is commonly of a sanious, sero-purulent, or sanguinolent nature. Occasionally small abscesses are scattered through the affected tissue, containing a yellowish, turbid serum, or thick curdy matter, not unlike that of a strumous lymphatic ganglion. In the subcutaneous cellular substance, these deposits are often enclosed by a thick layer of lymph, by which their contents are kept within their proper sphere. During the developeinent of this sac, the circumjacent tissue is red and indurated; but, as soon as the membrane is organized, as often happens when the irritation is protracted, these phenomena generally disappear, the parts gradually resuming their normal properties. The sac often acquires great thickness and density, layer after layer being deposited upon its internal surface, as is the case with the adventitious membranes in other situations, when they participate in the inflammation of the surrounding structures. This affection is rarely attended with much pain; indeed, were it not for the hardened and inflexible state of the affected part, the patient would experience but little inconvenience.

III. Induration of the cellular tissue constitutes a peculiar disease in children, which has been described by writers under the several appellations of cedematous hardening, scleroma, and skin-bound. It was first noticed as a distinct malady in 1718, by a German author, of the name of Uzembezius. Since that period it has been described, with great accuracy, by Denman and Underwood, of England, and by Doublet, Billard, and others, of France. The disease is comparatively rare in this country and Great Britain; but, on the continent of Europe, especially in the foundling hospitals of Paris, it is extremely prevalent and fatal, hundreds of infants annually dying with it. Many children, it would seem, come into the world with this affection, or are attacked within the first twenty-four hours after birth. Its progress is usually very rapid, most of the little patients being cut off in the course of three or four days.

The disorder sometimes affects the whole body; more com-

monly, however, it is restricted to particular regions, as the abdomen and inferior extremities. The skin in this affection is of a brownish color, interspersed with yellowish looking patches, and its texture is remarkably hard and firm, almost like leather. The subcutaneous cellular tissue is very dense and granular, communicating, when cut, the sensation of fibro-cartilage, calf's-foot jelly, or half-dissolved glue. Frequently it is of a bright lemon-color, and contains a large number of dark yellow granules, which are nothing but diseased adipous vesicles. The infiltrated matter is sometimes firm and concrete; but, in the early stages of the disorder it is commonly thin, and straw-colored, like serum, and readily coagulates by heat, alcohol, or dilute acid. The greatest induration is usually met with on the outer surface of the leg, and on the dorsal aspect of the hand and foot.

Associated with these morbid appearances, are various lesions of the internal organs. The lungs are hard, incrépitous, marbled, and congested; the oval foramen and arterial duct often remain patulous, or are but partially closed; the liver is extremely vascular, and the gall-bladder is distended with vitiated bile; the mesenteric glands are enlarged and injected; the gastro-enteric mucous lining more or less inflamed; and the whole venous system remarkably engorged with blood. Various opinions have been suggested respecting the precise nature of this affection; but the most plausible, decidedly, is that which ascribes it to inflammatory irritation, either of an acute or chronic character, which determines an effusion of sero-fibrinous matter into the meshes of the cellular tissue, closing up its cavities and hardening its texture.

The cellular tissue is liable to various morbid growths, deposits, and transformations. Amongst these the most common are cysts, melanosis, and fungus hæmatodes, neither of which will require particular notice in this place. Fibrous, cartilaginous, and bony formations are most prone to occur in the sub-serous cellular tissue of the chest, abdomen, and scrotum; in small grains, patches, or irregular incrustations. Such degenerations are extremely rare in the cellular tissue under the skin, and still more, if possible, in that of the mucous membranes. As occurring in the former situation, a highly interesting case has been given by Andral, of a patient who died of elephantiasis; on dissection, the subcutaneous cellular texture of the lower extremities was found to be excessively dense and indurated, possessing, in many places, all the physical properties of real cartilage.

IV. *Serous infiltrations* of the cellular tissue are very common in persons of deteriorated constitutions, and in those who have become exhausted by protracted diseases, profuse hemorrhages, and other affections impairing the vital powers. In cases of poisoned wounds, the effusion is generally very rapid, large in quantity, and highly acrid in quality. Various terms have been employed to designate this condition of the cellular tissue. Thus, when it is restricted to a particular region, as, for instance, the eyelid, leg, or scrotum, it is named *œdema*; whilst, when it is more extensive, or diffused over the greater part of the body, it is called *anasarca*. Neither of these appellations, it is obvious, is well chosen, as the one literally signifies merely a swelling, the other dropsy of the flesh. The interstices of the cellular tissue in this disorder are very much enlarged, and the skin over the part, which has generally a singularly glossy and tumid appearance, readily pits upon pressure. The effused fluid is of a sero-albuminous nature, as is evinced by its coagulability by heat, alcohol, and acids; and, according to the testimony of Dr. Blackall, an eminent writer on dropsy, it occasionally undergoes spontaneous concretion. These serous infiltrations, in whatever part of the body they may occur, ought to be regarded as the result of congestion of the capillary vessels, depending either upon inflammation, debility, or mechanical obstruction.

Hemorrhage always arises from a rupture of the blood-vessels, produced by external violence, or by some internal cause, the precise nature of which is not so well understood. In the former case, the fluid, although sometimes widely diffused, generally forms an elastic, circumscribed tumor, technically denominated an *ecchymosis*; in the latter, it is more commonly seen in small patches of a dark purple color, which have received the name of *suggillations*, death-marks, or cadaveric lividities. These spots, which are always most conspicuous on the posterior parts of the body, are very distinct in persons who die from petechial fevers, the plague, and the scurvy, and can be readily distinguished from ecchymoses by the entire absence of all signs of violence. Suggillations, however, do not always arise exclusively in the manner here indicated. In many instances, if not in most, they result merely from an accumulation of blood in the capillary vessels of the skin and cellular tissue, without any extravasation whatever. These facts should be borne in mind, as they have a most important bearing upon legal medicine. For the want of correct in-

formation upon this subject, errors the most serious have sometimes been committed by physicians.

V. *Emphysema* may be produced by a great variety of causes, but the most common are penetrating wounds of the chest, rupture of the air-cells, of the lungs, from violent coughing, or ulceration, and lesions of the lining membrane of the windpipe. Dr. Baillie supposes that it sometimes arises spontaneously, as the result of a process of secretion from the blood-vessels; and, in a considerable number of cases, it has been met with as an attendant on gangrene. The infiltration is sometimes very great, the air occupying nearly the whole of the cellular tissue. The distended parts have a bloated aspect, pit under the finger, and emit a peculiar crepitating sound, when pressed, not unlike the lungs.

V. *Foreign substances* are sometimes found in the cellular tissue. In most cases, they excite inflammation in the contiguous parts, and are finally discharged by suppuration. Not unfrequently, however, especially when they get admission through the alimentary tube, they become encysted; that is, the cellular tissue is condensed around them, and converted into a sac. At other times, again, after traversing the body in different directions, they are arrested, and work their way out through the skin, generally at the back of the hand and foot, though in this respect there is no invariable rule. It is thus that bullets and needles often pervade the subcutaneous cellular tissue, starting, perhaps, at the trunk, and gradually reaching the most distant parts of the extremities, and this, too, frequently without producing any serious mischief. Not long ago, a case occurred in one of the Parisian hospitals, where the cellular substance was literally loaded with needles, and yet the patient lived several years, in tolerable comfort, after she swallowed them.

VI. The cellular tissue is occasionally the

Fig. 8 *



* *a*, the head; *b*, the caudal extremity.

residence of *parasitic animals*, developed either in its substance, or introduced from without. Of these, the only one requiring notice is the *filaria medinensis*, (Fig. 8,) the little dragon, or Guinea-worm. This animal, which is extremely simple in its structure, generally occurs immediately beneath the skin. The legs and feet are the parts which it more commonly infests, but it has also been observed in the scrotum, the anus, and in different parts of the head and trunk. It is of a white color, about the thickness of a violin-string, and, when full grown, from five to ten inches in length; its diameter being nearly equal from one end to the other, except towards the tail, which is somewhat tapering and curled. The countries in which these worms most frequently occur, are Egypt, Arabia, Guinea, Persia, and Abyssinia. Several of them have been known to coexist in the same patient; and occasionally they have been found from three to four feet in length.

CHAPTER III.

Of the Adipous Texture.

Organization.—Exists only in particular regions of the Body.—Office of the Adipous Vesicles.—Nature and Uses of the Fat.—Lesions of the Adipous Tissue.—Wounds.—Liability to Inflammation.—Hypertrophy, general and local.—Adipous Diathesis.—Atrophy.

THE adipous texture consists of an infinite number of vesicles, which are variously arranged in different regions of the body, and the diameter of which scarcely exceeds the eight hundredth part of an inch. In their natural state, these little reservoirs are of a spherical shape, and are so closely agglomerated as to resemble clusters of fish-spawn; but, when their contents are partially absorbed, they assume a flattened appearance; and, in great emaciation it is often impossible to distinguish them from the cellular substance in which they are immersed.

The parietes of the adipous vesicles, are formed out of the cellular element: they are excessively delicate, and so transparent as to render it difficult to distinguish them, even with the aid of a magnifying instrument, from their own contents. Each reservoir receives an arterial and venous branch, together with a nervous filament and a lymphatic vessel, by which it is attached, as by a sort of foot-stalk, to those immediately around it. The precise arrangement of these structures is not ascertained, but is probably not different from what it is in other parts of the body.

Modern researches have disclosed that these little vesicles (Fig. 9) do not communicate together, as was formerly supposed by anatomists and physiologists. They are, indeed, perfectly distinct the one from the other, and hence the fat which they contain never escapes until they are ruptured. If it were not for this arrangement, the contents of these reservoirs would be constantly liable to extravasation, and, like the water of anasarca, gravitate towards the most depending

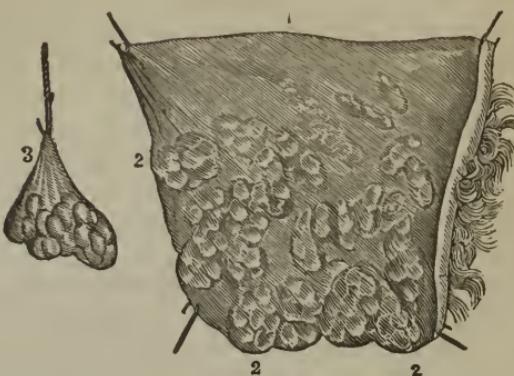
parts of the body, interfering thereby not only with the freedom of its movements, but leading to the most hideous deformity.

The texture before us does not, like the cellular, exist in all parts of the body. There is none in the parenchymatous and glandular organs, in the cartilages, tendons, fibrous membranes, and lymphatic ganglions. The lids and the eye, the scrotum and penis, the uterus, clitoris, and nymphæ, are also deprived of it. The brain has no adipous substance, at least not in a free state ; and the same is true of the spinal cord, together with most of the nerves. On the other hand, it generally exists in great abundance in the subcutaneous cellular tissue, in the orbits about the kidneys, in the folds of the peritonæum, and in the interior of the long bones, where it constitutes what is vulgarly called the marrow. There is frequently a considerable quantity around the heart and great vessels, particularly in old, corpulent subjects, and the larger intervals between the muscles are usually filled with it.

In its mode of arrangement, the adipous tissue exhibits considerable diversity, according to the locality in which it is examined. Under the skin, it is spread out in the form of a lamella, the thickness and density of which vary in different parts of the body, as well as in different individuals. In the orbit of the eye, and on the cheek, it occurs in rounded packets, whilst in other situations, as in the great omentum, it presents itself in narrow band-like strips, or in the form of pedunculated masses, as in the epiploic appendages.

The office of the adipous vesicles is to deposit the fatty matter which they contain. How this elaboration is effected, it is needless to inquire ; for, beyond the mere circumstance of

Fig. 9.*



* 1, a portion of adipous tissue; 2, minute bags containing fat; 3, a cluster of bags separated and suspended.

the elements of this substance being found in the blood, nothing whatever is known. The process by which these elements are combined, so as to form the adeps, is still completely enveloped in mystery, if, indeed, it is susceptible of explanation. Oil and fat have been detected in the general circulating mass by Traill, Thackrali, Chevreul, Lecanu, and other experimentalists; and it is not improbable, therefore, that the office of the arterial capillaries of the adipous vesicles simply consists in evolving the principles of these substances from the fluid with which they are incorporated.

The fatty matter, considered apart from its containing vesicles, is of a light yellowish tint, owing to the presence of a peculiar coloring principle, which is easily removed by washing. During life, it varies in its consistence, from the condition of a liquid to that of a semi-concrete substance, being naturally softer in some parts of the body than in others. After death, it is always more solid. Possessing all the characters of the fixed oils, it is specifically lighter than water, has a mild, insipid taste, and is completely inodorous when fresh, but soon becomes rancid and offensive by exposure to air and heat. Fat is one of the few animal substances which do not contain azote. We learn from the experiments of M. Chevreul, a French chemist, that it is formed of two proximate principles, elaine and stearine, the former of which is of a fluid consistence, and an oily nature, the latter, solid, white, rather shining, and easily fused when heated. The relative proportions of these materials vary in different parts of the body. The marrow of the bones appears to be almost entirely composed of elaine.

Besides serving as a sort of aliment in reserve, the fat moderates in certain regions — the effects of pressure — fills up the voids between the muscles and the skin, and probably assists in preserving the temperature of the body. That it contributes to the production of this latter result, may be inferred both from the circumstance of the fat being a bad conductor of caloric, and from the fact that almost all arctic quadrupeds are abundantly supplied with it, — Providence thus enabling them to defy the most dreadful extremities of cold, and to sustain a high temperature even under the eternal ice of the poles. But the most important use of the adeps is the part which it performs in the nourishment of the system, when the stomach is temporarily disqualified from carrying on the digestive function, in consequence of local or

general disease. The adipous vesicles in such cases are robbed of their contents, which, being taken up by the absorbents, are conveyed into the circulating current, to be reconverted into blood. It is owing to this removal of the fat that persons recovering from painful and protracted indisposition have such a constant desire for food, being tormented, if I may so express myself, with an omnipresent appetite. The demands of the system, under such circumstances, are of the most urgent nature, every adipous vesicle, every fibre, and every organ calling aloud, as it were, for nourishment, and for a share of the fatty matter which it contributed to the support of the body, at a time when the digestive apparatus, languid and oppressed with disease, was incapable of performing its accustomed functions. The same thing is beautifully exemplified in hibernating animals which are very fat, on retiring to their winter quarters, but are always lean on the return of spring, when they awaken from their torpid state.

Wounds of the adipous tissue present nothing unusual in their mode of healing: they generally unite without difficulty, in fact, not unfrequently by union of the first intention. When the divided parts are kept asunder, the fatty matter is gradually absorbed, and the restoration is finally effected by the granulating process, as in similar injuries of other textures.

It has been questioned by some, whether the adipous tissue is susceptible of *inflammation*, the opinion having arisen, probably, from the belief, at one time very current amongst physiologists, that this substance is not endowed with a sufficient degree of vitality for this process to take place. In endeavoring to solve this problem, the reader should bear in mind the distinction between the adipous tissue, properly so called, and the fat. The one, as has been already seen, is an organized substance, provided with blood-vessels, nerves, and absorbents, and is, therefore, liable to the different kinds of inflammation; the other, on the contrary, being inorganic, must, of course, be insusceptible of morbid action. In acute inflammation, the adipous tissue assumes a dark reddish aspect, and always manifests a peculiar tendency to slough, in consequence, it would seem, of its vascular and nervous endowments being too feeble to offer the necessary resistance. In peritonitis, I have several times seen the fatty omentum inflamed in one part, and gangrenous in another, though there was little effusion of lymph or serum.

The adipous tissue is liable to *hypertrophy*. This may be either general or partial. Various attempts have been made to estimate the standard amount of fat; but, as the quantity varies in different individuals, and even in the same person, under different circumstances of health and disease, it is obvious that there must be great difficulty in arriving at a satisfactory conclusion. The majority of anatomists, however, agree in the opinion that in an adult of ordinary size, it forms about one twentieth part of the entire body. Thus, a man weighing one hundred and sixty pounds, would have about eight pounds of fat. But, in cases of obesity, it often greatly exceeds this quantity; and, on the other hand, in emaciation it often falls far below it. In general hypertrophy, the quantity of fat is sometimes enormous, amounting to five or six times the weight of the entire body. The celebrated Pritchard, of Kentucky, who exhibited himself in Litton's museum, in this city, in 1834, weighed five hundred and fifty pounds. The Canadian giant, as he was called, whom I saw in Philadelphia, in 1829, weighed six hundred and eighteen pounds. He was six feet four inches in height, and the circumference of each leg, around the calf, was nearly three feet. The most remarkable feature in this case was, that this enormous deposit of fat, making him so much larger than ordinary men of the same stature, was confined chiefly to the abdomen and lower extremities, the thorax, shoulders and arms being little stouter than in other persons. Daniel Lambert, of England, who died at the age of forty, weighed seven hundred and thirty-nine pounds; and the German journals give the case of a man who weighed eight hundred pounds. The individual was carried off by fright, and, on inspection, the fat of the abdomen was found to be nearly fourteen inches thick. An account of a somewhat similar case has been published by the late Professor Dupuytren, of Paris. The individual, who was a poor beggar-woman, measured five feet one inch in height, and five feet two in circumference. The thoracic and abdominal cavities were enormously loaded with adeps, and, on the mammae, the subcutaneous layer was seven inches in thickness. But the most extraordinary example of this affection, of which I have any knowledge, has recently occurred in the State of New York, in a girl that weighed three hundred and sixty-four pounds, though only ten years and a half old.

There would thus seem to be, from the above detail of cases, sometimes a real adipous diathesis, nearly all the materials entering the circulating mass being converted into fat.

Various articles of food and drink have a tendency to bring about this state of the system. Malt liquors, taken to excess, and the moderate use of wine and ardent spirits, are, perhaps, the most powerful means for producing general hypertrophy of the adipous tissue. But, whatever may be the exciting causes of these depositions, certain it is, that indolence and freedom from care are necessary, if not essential, to the process. Castration is generally followed by considerable obesity ; and the same thing has long since been observed in women that have been deprived of the ovaries, or in whom these organs are diseased or imperfectly developed. Similar phenomena have been noticed in animals, after the removal of the spleen³; though the obesity, in these cases, is generally only temporary, the body gradually returning to its former weight and spareness. Whether the same changes have ever been witnessed in the human subject, as the result of the extirpation of this organ, I am not prepared to say, as there are no data from which to judge. In birds, considerable accumulations of fat sometimes occur in a very short time. Thus, when the ground is loaded with insects and other nutritious substances, robins and thrushes will occasionally fatten to such an extent, in the course of twenty-four hours, as to be almost unable to get out of the way of the sportsman.

Partial hypertrophy of this texture is well exemplified in *adipous tumors*. Generally developed under the skin, these tumors not unfrequently occur within the abdominal cavity, in connection with the peritonæum. Their size, though commonly small, is sometimes enormous. Sir Astley Cooper gives an account of one that weighed nearly thirty-eight pounds ; and in a recent French journal are recorded the particulars of another that weighed still more. In their shape, these tumors are usually somewhat globular, but as their bulk augments they are apt to become elongated, and to assume a pyriform, gourd-like, or pediculated configuration. Oftentimes their surface is lobulated, irregular ; and when cut into they are found to be composed of large rounded masses of fat, which differs in no respect from the adipous texture in other situations. They are surrounded by a thin but firm capsule of cellular substance ; and their supply of blood is by no means so liberal as might be supposed from their size, and the rapidity of their growth. These tumors sometimes exist in considerable numbers. Dagorn, a French physician, mentions an instance where there were as many as eight, several of them of prodigious size, in different parts of the body.

In abdominal obesity, the encumbered organs are often literally buried in beds of fat. The tumors are generally more pediculated than those which are developed under the skin, and they may grow either on the omentum, from the epiploic appendages, or beneath the peritonæum, giving that projecting rotundity to the abdomen which is vulgarly distinguished by the name of "pot-belly," and which is so well described by Prince Henry, in his address to Falstaff, as "a huge hill of flesh," "a globe of sinful continents."

Large quantities of fat occasionally envelope the kidney. In a specimen which I took from an old man a few years ago, the mass amounted to three pounds; and Dr. Horner refers to one, removed from a bullock, which filled a common-sized wash-tub.

In the chest large masses of fat sometimes surround the pericardium, and, by compressing the heart and great vessels, induce palpitation, and even fatal syncope. Of this, an interesting case is to be found in the admirable treatise of Senac.

Atrophy of the adipous tissue, which is far more common than its preternatural accumulation, may arise from one or other of the following causes: defective or unwholesome diet; organic lesions of the lungs, heart, stomach, or bowels; protracted abstinence, as in fasting, sickness, and the periodical sleep of hibernating animals; excessive loss of blood; immoderate indulgence in ardent spirits; long watching; exposure to intense heat; severe study, and great bodily fatigue. This is well exemplified in the case of grooms, and in persons who make long journeys on horseback. Captain Riley, of Ohio, who was shipwrecked on the coast of Africa, and captured by the natives, was reduced from two hundred and forty to ninety-two pounds, from excessive exercise, partly on an old camel, partly on foot, across the sandy desert. There seems to be a great diminution of this substance sometimes, without our being able to assign any satisfactory cause; as, for example, in the case of the celebrated Calvin Edson, who, although apparently in good health, was literally nothing but skin and bone, his entire weight not exceeding fifty-eight pounds.

The removal of the fat, by whatever cause induced, is effected probably by the conjoined agency of the veins and lymphatics; but upon this subject physiologists are by no means agreed, some ascribing it exclusively to the former, others to the latter, of these vessels. It would be interesting

to know in what form this substance is absorbed, whether as oily matter, or after undergoing decomposition. Facts are not wanting in support of both these views; but it must be confessed, that, whilst the one is plausible, the other, namely, the last, is infinitely most in accordance with the laws and operations of the living system. The adipous vesicles, in this affection, diminish in size; and, as their walls are brought in apposition, an erroneous opinion has hence arisen, that they are sometimes entirely obliterated.

The adipous tissue is occasionally the seat of *melanosis*, which is either disseminated in minute inky spots, or deposited in small, spherical tubercles, of a concrete or semi-fluid consistence. Most commonly it occurs in the fat of the orbit, the anus and rectum, in the mesentery and omentum, and around the kidneys. It has also been noticed in the subcutaneous adeps, but much less frequently than in the situations here indicated.

Fatty transformations are not unfrequently met with. How they are produced, the present state of our knowledge does not enable us to explain. It is not improbable, however, I think, that they are partly, if not entirely, the result of a tardy inflammatory action, causing a perversion of the nutritive function. These changes, which have hitherto been noticed chiefly in the heart, liver, mammae, and voluntary muscles, will be described in their appropriate places.

Men of anxious mind and fretful temper seldom get fat. With what justice does Shakespeare, in one of his most magnificent plays, make Cæsar say, —

"Let me have men about me that are fat;
Sleek-headed men, and such as sleep o' nights.
Yond' Cassius has a lean and hungry look:
He thinks too much: such men are dangerous." *

* Julius Cæsar, act i. scene 2.

CHAPTER IV.

Of the Muscular System.

SECTION I.

Of the Muscles.

- I. *The Muscles.* — Different Classes. — Structure. — Color and Consistence. — Chemical Analysis. — Sensibility. — Reunite when divided. — Inflammation. — Suppuration. — Mortification. — Chronic Irritation. — Softening. — Induration. — Ossification. — Fibrous and Fatty Transformations. — Heterologous Deposits. — Hypertrophy. — Atrophy. — Parasitic Animals. — Sanguineous Effusions. — II. *The Tendons.* — Appearance and Organization. — Reunite when divided. — Inflammation. — Ossification. — Atrophy. — Diseases of the Sheaths of the Tendons. — III. *The Aponevroses.* — Structure. — Acute and Chronic Inflammation. — IV. *The Synovial Burses.* — Situation and Structure. — Are liable to Disease. — Fibro-cartilaginous Concretions. — Hypertrophy. — Hydatoid Bodies.

ALTHOUGH it is my design, in the present chapter, to speak only of the lesions of the voluntary muscles, yet this appears to be the proper place for making some remarks on the minute structure of the system generally of which they are a part.

The muscles, constituting what is familiarly called the flesh, may be divided, in reference to their functions, into three great classes, — the voluntary, involuntary, and mixed. These differ considerably from each other, not only as regards the special impressions which they require to call them into action, but likewise in respect to their physical properties, and the arrangement of their fibres, together with several minor points which it is unnecessary to dwell upon in a treatise of this kind.

The *muscles of volition* embrace those of the trunk, head, and limbs, of the tongue, the soft palate, the larynx and pharynx; and, as their name implies, they are strictly under the control of the will. They are supplied by the spinal nerves, on the division of which their action is paralyzed, and they consist each of a body and two extremities, which,

in most instances, are tendinous or aponeurotic. The number of voluntary muscles has been variously estimated, but may be stated at about four hundred and fifty. They are of a florid red color, and their size, as well as shape, varies in different regions of the body, the principal bulk of which they form.

The *involuntary muscles* comprehend the fleshy layers of the alimentary tube, from the cardiac extremity of the stomach to the anus, together with those of the heart and the urinary bladder. They are in general of a much paler color than the preceding class, and their fibres are spread out so as to form tunics to the hollow viscera ; the cavities of which they diminish by their action, and thus serve to propel their contents. No tendons are appended to these muscles, excepting in the case of the heart. They are supplied by the branches of the great sympathetic ; and they are consequently enabled to carry on their operations without a conscious effort of the will. Like the preceding class, they have their alternate periods of action and repose, and they are the agents of important vital functions which it would have been dangerous to leave under our control.

The *third class* consists of the diaphragm of the œsophagus, together with the trapezoid, sterno-inastoid, intercostal, scalenus, and serrated muscles. The office of these bodies is to preside over the function of respiration. In their color and consistence they do not differ from the voluntary muscles ; but they are supplied by a distinct system of nerves, namely, the respiratory of Sir Charles Bell ; and they are therefore, as far as their action is concerned, of a *mixed* character, being partly involuntary, yet not wholly withdrawn from the influence of the will. It may be observed, *en passant*, that, in certain diseased states of the body, the voluntary muscles become involuntary, and the involuntary voluntary, though the latter circumstance is much less frequent than the former.

All muscles are composed of fibres, (Fig. 10,) which are themselves resolvable into minute filaments, held together by cellular substance. In many of the larger muscles, *bundles*, *fasciculi*, or *lacerti*, are observable, which vary very much in magnitude and distinctness : thus they are very large in the gluteal and deltoïd, in the fleshy columns of the heart, and in the longitudinal bands of the colon. In general they run parallel to each other, being separated merely by a thin

layer of cellular matter; and, in some situations, they lie so far apart as to appear like so many muscles. By dissection, these bundles can be divided into *fibres*, which are rendered still more conspicuous by boiling, or immersion in alcohol. The form of these fibres, which is nearly the same in all parts, is prismatic, pentagonal, or hexagonal, but never cylindrical; and they appear to extend in a continuous manner from one extremity of the muscles to the other. This arrangement, we are informed by Prochaska and Bichat, actually obtains, even in the longest muscles, as the *gracilis* and *sartorius*.

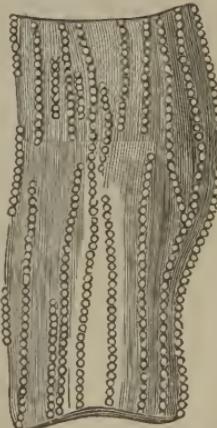
The *ultimate filament* (Fig. 11) has been carefully examined by a great many distinguished physiologists, but thus far, owing to its excessive tenuity, no very satisfactory information has been elicited. It is thought by some to consist of a series of rounded corpuscles, about the two thousandth part of an inch in diameter, which are connected by cellular substance so as to look like a string of pearls or a row of beads. It is pretty generally agreed, however, since the publication of the researches of Hodgkin, Lister, Grainger, and others, that this view is incorrect, the observations of these gentlemen having led them to conclude that the ultimate filament is a peculiar pulpy structure, arranged into threads of extreme minuteness, which are placed close and parallel to each other, and intersected by a great number of the most delicate transverse lines. Similar results were obtained, long ago, by Fontana.‡

Thus formed, the muscles are enclosed, in general, by an aponeurotic sheath, the

Fig. 10.*



Fig. 11.†



* A portion of muscle enclosed in a fibrous sheath.

† Ultimate fibres of a muscle highly magnified, showing the string of globules of which they are supposed to exist.

‡ *Traité sur le Venin de la Vipere*, t. ii. p. 228.

degree of condensation of which varies in different situations being very close in some, but slight in others. The connection between this structure and the organ it invests is effected by cellular substance, which is at the same time prolonged inwards, furnishing thus a distinct covering for each fasciculus, for each fibre, and for each ultimate filament, its delicacy becoming greater and greater as it passes from the one to the other, until at length it escapes the naked eye. No aponeurotic sheaths envelop the muscles of organic life: they are interposed, for the most part, between the mucous and serous membranes, and their interstitial cellular texture is not less abundant, but so short and condensed as to render it difficult to separate the fibres from each other.

With the exception of the mucous membranes, the skin, and some of the internal viscera, the muscular tissue is more abundantly provided with vessels, absorbents, and nerves, than any other substance of the body. The *arteries*, derived from the neighboring trunks, penetrate the muscles at different points of their periphery, creeping, in the first place, between the larger bundles, then between the smaller, and, finally, between the fibres, their ultimate branches being spent upon the ultimate filament. By means of the microscope, they may be seen ramifying upon the surface of the delicate web of membrane that encloses the muscular pulp, but cannot be traced into it. The arteries are generally proportioned to the size of the muscles which they are destined to supply, though, in this respect, there is some diversity. The *accompanying veins* are arranged into two sets; some follow the arteries, and the others run superficially on the surface of the muscles. They are large, somewhat flexuous, and may be easily injected from the adjacent trunks, notwithstanding the presence of numerous valves. The *absorbents* are quite abundant: they pursue pretty much the same course as the sanguiferous vessels, but of their mode of origin nothing whatever is known.

The muscles are furnished with *nerves* in proportion, not simply to their volume, but to the variety, frequency, and vivacity of their movements. Hence the reason why some of these bodies that are comparatively small, but which are destined to perform many combinations of actions, are much better provided in this respect than others double their size, but with more simple functions. As a general observation, it may be stated that the muscles of volition receive large and numerous cords; whereas the involuntary, in proportion

to their magnitude, are sparingly supplied. The filaments of the nerves usually accompany the sanguiferous vessels, particularly the arteries, to which they are imbeded by cellular substance. They enter the muscles at different points, and at length, after many divisions, they become so minute as to elude all observation. There is, consequently, some uncertainty concerning their ultimate termination, notwithstanding the numerous attempts that have been made to detect it. Before they disappear, they part with their cellular envelope, by which circumstance they are rendered soft and transparent, and brought in more immediate contact with the substance in which they end. Sir A. Carlisle states that the ultimate termination is in the cellular web that encloses the muscular pulp. On the other hand, Provost and Dumas, who have more recently investigated the subject, maintain that the nervous filaments are not actually spent upon the muscles, but that they return on themselves, and pass either to the trunk which furnishes them, or anastomose with some neighboring ones, either of the same or of a different class. But this is a topic which is interesting rather in a physiological than in a pathological point of view, and we shall therefore dismiss the further consideration of it.

It has been already stated that the muscles are of a *red complexion*, and, it may now be added, that the intensity of their color varies not only in different persons, but likewise in the same individual in different regions of the body. Thus the voluntary muscles are of a florid color, whilst the fleshy fibres of the intestinal tube and the urinary bladder are always several shades lighter, being in some places, indeed, of a rosaceous gray. Generally, too, these bodies are of a deeper hue in adults than in children and old people, and in those who are constantly engaged in laborious exercise than in such as are indolent, or make but little use of their limbs. Hence it may be assumed as an axiom, that the florid complexion of the muscles is in direct ratio to the frequency and energy with which they are employed. The truth of this remark is strikingly exemplified in the muscles of the arm of the blacksmith, as compared with those of the arm of the student; the latter of whom seldom uses his upper extremities except for the purpose of turning over the leaves of his book, or gratifying the appetites of hunger and thirst. Hence, his muscles are, throughout, soft, pale, and flabby; whereas those of the laborer are hard, firm, and of a deep red color.

The red color of the muscular tissue is altogether accidental, or does not, so to speak, form an essential attribute of this substance. Depending entirely upon the amount of blood which it contains, it can be readily removed by repeated washing, or by maceration in alcohol or alkaline fluid, the fibres remaining in other respects unchanged. Hence the color of the muscular tissue, observes an eminent writer, varies with that of the blood,—is dark when it is dark, pale when it is pale, and white when it is white.

As the color of the muscular texture varies, so also does its *consistence*. It always contains a much larger amount of moisture in the young than in the old, and is therefore much softer, as well as more pliant and lacerable. Exercise, as we have just seen, exerts a great influence over the consistence of the muscular tissue; and it has long been a matter of observation that there are some subjects in whom it is naturally more soft and juicy than in others. Its cohesive powers are very feeble, and it is wholly devoid of elasticity. On the other hand, it is highly flexible and extensible.

The *analysis* of the muscular texture shows it to be composed of fibrin, albumen, gelatine, osmazome, leucine, free lactic acid, and various kinds of salts. The most remarkable circumstance, perhaps, which chemistry has brought to light in this investigation is, that *nitrogen* exists in a larger proportion in the flesh of old than that of young subjects, and in warm blooded animals than in reptiles and fishes. The quantity of gelatine and albumen is in an inverse ratio in the different periods of life, the former predominating in infancy, but entirely disappearing as we advance in years. It is difficult to say whether the gelatine is to be regarded as proper to the muscles, or as being derived from the cellular substance which enters into their composition. The latter supposition, on the whole, is perhaps the most correct.

The distinctive attribute of the muscular tissue is *contractility*, or that property by virtue of which it alternately shortens and elongates its fibres. The chief purpose of this function is to enable us to carry into effect our various resolutions and designs, or, in other words, the mandates of the will. Three conditions are necessary to the successful execution of this function: 1. a sound state of the muscle; 2. a free and uninterrupted nervous communication; 3. a healthy state of the cerebro-spinal axis. For the production of the involuntary movements, only two conditions are re-

quired, namely, a sound state of the fleshy fibres, and the action of an appropriate stimulant. Thus, the blood is the proper and accustomed stimulant of the heart, the urine of the bladder, the food of the stomach, the bile and fœcal matter of the intestinal tube.

Finally, the *sensibility* of the muscles, notwithstanding their great nervous endowments, is rather obscure, and, like that of all other organs, is of a peculiar character. When these structures are subjected to severe exercise, a feeling of lassitude is experienced, often amounting to considerable uneasiness. The distressing sensations in the back and limbs of patients laboring under bilious and intermittent fevers, as well as in some other diseases, are doubtless seated in the muscular texture, instead of the bones, to which they are usually referred by the vulgar. In amputations, the division of the muscles is never attended with the same degree of pain that is felt in cutting through the skin. Yet, although the organs in question enjoy little sensibility in the healthy state, the suffering from them, when inflamed, is sometimes truly exquisite, and almost intolerable.

The voluntary muscles, when divided, *unite* by adhesive inflammation, with nearly the same facility as the cutaneous and cellular textures, the period required for the reparation varying according to the extent of the injury and the nature of the constitution. If the edges of the wound be allowed to remain apart, the restoration is effected through the medium of granulations, the growth of which is often rapid and luxuriant. As the healing advances, these bodies contract in volume, and are ultimately converted, by a modelling process, into real muscular tissue, or, at all events, into a substance so closely resembling it as to render it difficult to distinguish them from each other. I cannot understand upon what grounds the partial regeneration of the muscular tissue has been denied by some anatomists. That the bond of union is occasionally of a fibrous, ligamentous, or even cartilaginous character, as is contended by these writers, cannot be doubted; but that such is not the course which nature generally pursues, even in old persons, the observations of every one must fully convince him. Is it more difficult to conceive of the partial reproduction of a muscle than of a bone? Certainly not, especially when it is remembered how much more delicately the one is organized than the other; or, what is the same thing, how much more liberally it is

supplied both with vessels and nerves. Yet, notwithstanding, how often does it not happen that some of the largest pieces of the skeleton are almost wholly regenerated when destroyed by necrosis. I do not contend that a muscle, similarly affected, is ever completely reproduced ; for, upon this subject, I have no personal experience : I should imagine the circumstance, however, to be within the range of possibility : but that it is extremely rare is sufficiently evident from the few cases of it which are on record.

The principal lesions of the voluntary muscles are inflammation, change of consistence, ossification, atrophy, and their conversion into a substance resembling fat.

Inflammation of the muscles is by no means so common as in some of the other textures. It is not improbable, I think, that it sometimes commences in their own substance ; but much more frequently it is communicated to them from the contiguous parts, as the intervening cellular structure, and the aponeurotic expansions, by which they are connected and enclosed. The disease here, as elsewhere, may be acute, as when it is caused by wounds or external injury, or chronic, as when it is associated with gout and rheumatism. In either case, it is generally limited to particular muscles ; though, in a few rare instances, it affects a whole group of them, either simultaneously or successively. As comparatively few opportunities have occurred for studying this lesion, it is not surprising that a good account of its anatomical characters should still be a desideratum.

The initial step in the acute form of the disease, as well, perhaps, as in the chronic, consists in an engorged state of the vessels of the connecting cellular texture, which, in consequence, loses its natural whiteness, and assumes a faint red complexion. The fleshy fibres are at the same time increased in density, though as yet they have experienced no change of color. Gradually, however, their vascularity is augmented, the affected part becomes rigid, and their contractile power is so much impaired that motion is not only difficult but painful, the muscle, the subject of the disease, being the seat of constant spasmodic actions.

At a more advanced period, when the disease has reached a higher grade of intensity, the connecting cellular tissue is swollen, and infiltrated with serosity, intermixed with globules and shreds of lymph. The muscular fibres are of a deep mahogany hue, soft, flaccid, easily torn, and scarcely distin-

guishable from the surrounding parts. The discoloration, although sometimes uniform, and diffused over a large extent of surface, more commonly occurs in irregular patches, with intervals of sound substance. In violent cases, it is not unusual to find small ecchymoses, caused by the rupture of some of the capillary vessels. The muscle, at this advanced stage, is totally changed in its character, and there is generally more or less effusion of serum, lymph, and blood, between it and the circumjacent structures, with inflammatory appearances of its aponeurotic sheath. The ordinary stimulants, as might be supposed, no longer exercise their accustomed influence. The fleshy fibres remain rigidly fixed, in spite even of the division of the main nerve. Galvanism also fails in producing the usual phenomena.

It is seldom that inflammation, whether acute or chronic, passes into *suppuration*. This rare occurrence is most frequently witnessed in neglected erysipelas of the extremities; but the most perfect example of it is that which is seen in what is called psoas abscess; whence the psoas and iliac muscles sometimes entirely disappear, being converted into a large purulent sac, extending from the first lumbar vertebra to the groin. The pus, which is of the same nature as in other parts of the body, is deposited originally in small disseminated globules, which give the affected part a singularly speckled appearance.

Not less rare is *mortification* of the external muscles. This termination has hitherto been observed chiefly, if not wholly, in erysipelatous and carbuncular inflammation, occurring in old worn-out subjects. The lesion is easily recognized by the altered color of the fleshy fibres, which are usually of a dark, cineritious aspect, by their softness and lacerability, and by their gangrenous odor. The sloughs are detached in ragged shreds, bathed by a thin, dirty, sanious, and offensive fluid. The injured muscle is never entirely regenerated, and, if the sphacelus be extensive, it generally proves fatal.

In *chronic inflammation*, the muscular tissue loses its florid complexion, and assumes a pale yellowish appearance, not unlike that of an autumnal leaf. Its consistence is also increased; and the fleshy fibres, which are often very much thickened, are so firmly glued to each other as to render it difficult to separate them. This form of myositis, as before intimated, occasionally terminates in suppuration. Another effect, which is still more rare, is *ulceration*. This is some-

times observed in phagedenic sores of the leg, extending in succession through the skin, cellular substance, aponeurosis, and, finally, the muscular texture. The most remarkable circumstance about these erosions is the disappearance of the fleshy fibres, or their conversion into fibrous substance. When the constitution is good, the restorative process generally goes on kindly, and the ulcer is soon filled with healthy granulations.

The muscles are occasionally deprived of their natural *consistence*. The diminution of cohesion to which this alteration gives rise is generally limited to particular muscles, or even to particular portions of them. The exciting causes of this affection are still involved in considerable obscurity; but that it frequently depends upon irritation and loss of nervous power, does not admit, it seems to me, of any reasonable doubt. In proof of the justice of this view, it may be added, that the lesion we are now contemplating is unusually connected with inflammatory appearances of the collateral tissues, or with general or partial paralysis. De Haen relates a remarkable example of softening of the muscles of an individual who was seized with palsy of the superior extremities, after an attack of painter's colic; and similar instances are recorded by Barthez and other writers. In both the cases mentioned by these authors, the affected structures were of a soft, pulpy consistence, but gradually regained their normal character as the enteric disease subsided. A flaccid condition of the muscular system often coexists with what is termed the tubercular cachexy, and with a watery and impoverished state of the blood. By whatever cause the lesion is induced, the fleshy fibres are unusually pale, bordering on light fawn, flabby, and easily lacerable, the slightest pressure being sufficient to convert them into a soft, pulpy mass.

The reverse of the condition now described is sometimes observed, namely, a considerable degree of *induration* of the muscular tissue. This lesion, which appears to arise from the effusion of plastic lymph into the interstitial cellular substance, is frequently seen in the neighborhood of fractured bones, around scirrhouous tumors, and in the legs of persons affected with elephantiasis, gout, and rheumatism. Under the influence of these causes, the muscular fibres are rendered hard and firm, and, in some instances, almost cartilaginous. The color, in the early stage, is simply brown:

subsequently it acquires a pale reddish tint, and at a still later period the part exhibits a grayish leaden aspect, with here and there a spot retaining a portion of its natural complexion.

It has been doubted by high authority, whether the muscular texture is ever the seat of *ossification*. I am myself inclined to think, with Andral and others, that the primitive locality of the deposition is the interstitial cellular substance, from whence it gradually extends to the fleshy fibres, blanching and extenuating them, or even wholly destroying them by absorption. This degeneration, though commonly confined to individual muscles, occasionally affects a great number of them. A striking example, in which the whole muscular system exhibited the ossific diathesis, is recorded by Dr. Henry, an English practitioner.* The patient was a laborer, nineteen years of age, and the disease, as is usual in such cases, was connected with exostotic enlargements of the bones. A painful swelling was first perceived at the right wrist, which, as it increased, gradually involved all the muscles of the fore-arm, and converted them into one solid mass as high as the elbow. The left limb was attacked in a similar manner; then the right leg, from the ankle to the knee, and finally the shoulders and hands, rendering the superior extremities completely stiff and useless. Of the individual muscles, those of the loins, shoulder, and calf, are more particularly liable to suffer from this transformation.

In gouty and rickety subjects, whitish stone-like concretions are occasionally found in the muscles: they are usually of a spherical shape, with a volume seldom exceeding that of a pea, and consist principally of phosphate and carbonate of lime, cemented together by a minute quantity of animal matter.

I have never seen the true conversion of the muscular into the fibrous texture; but a number of examples of this kind have been recorded by others. The degeneration sometimes involves whole muscles, which, when the change is completed, scarcely retain a single vestige of their original features, save their shape, and even this is often materially altered. The deltoid and sterno-mastoid appear to be more frequently affected in this way, than any other parts of the muscular system, — for what reason is not known. The cause of the present transformation admits of easy explanation.

* London Philosophical Transactions, vol. xxi. p. 89.

Whenever a muscle is placed in a state of total inactivity, it experiences a modification of nutrition, by which, without any appreciable irritation, it gradually loses its fleshy character, and is converted into a fibrous substance, the economy making an effort, so to speak, to get rid of it, as a structure that is of no further use. This view of the case derives confirmation from what occurs in the inferior animals. In some species of quadrupeds, parts that are distinctly muscular in early life, are subsequently, by some change in the function of nutrition, transformed into another texture, better adapted to the wants of the system than one which is simply contractile.

Another lesion to which the muscles, in common with several other organs, are liable, is the *fatty degeneration*. In this affection they generally retain their original form and volume, though in some instances they are partially shrivelled and disfigured. They are of a pale straw-color, or even entirely white, unctuous to the touch, and rather diminished than increased in consistence. Notwithstanding all this, however, the linear arrangement of their fibres is not only recognizable by the eye, but can be easily traced with the scalpel. On pressure, a clear oily fluid oozes out, which greases the finger, or whatever else is brought in contact with it, and is of an unusually inflammable nature. According to the analysis of Cruveilhier,* muscular tissue, which has undergone the adipous degeneration, consists of an oily liquid, probably elaine, gelatine, adipocire, solid fat, and a substance resembling boiled flesh. These materials, the quantity of which is valuable, are not deposited between the muscular filaments, as has been conjectured by some, but form actually a part of their component principles. It is worthy of remark, however, that the interstitial cellular element is always considerably altered, being of a whitish color, very soft, and lacerable.

The fatty transformation is most marked in the muscles of the loins, hip, thigh, and leg of old persons affected with paralysis. It is likewise observed, in some rare instances, in the muscles around unreduced luxations, large exostoses, and old deep-seated ulcers. When the change is complete and extensive, it occasionally involves the corresponding tendons and aponeuroses, which, in consequence, lose their polished, satin-like lustre.

* *Essai sur l'Anatomie Pathologique*, t. i. p. 189.

It rarely happens that we have an opportunity of observing *tubercles* in the muscular tissue. When present, they are generally connected with a strumous diathesis, and coexist in other parts of the body. Otto states that he has several times seen tubercles in the muscles of the neck and thigh of scrofulous monkeys; and Andral has noticed similar bodies in the muscles of the hog. In the case to which the latter writer refers, they occurred in association with small transparent hydatids, evidently of the cysticercic kind.

Not less rare is *melanosis*. The first of these deposits is sometimes seen in the form of an infiltration, which imparts its peculiar stain to the muscular fibres, and converting them into a soft, pulpy substance, in which it is impossible to recognize the slightest trace of the primitive structure. Occasionally, again, the black matter is encysted, presenting an irregularly spherical mass, of pretty firm consistence, the volume of which varies from that of a pea to that of a foetal head. This morbid formation is sometimes directly chargeable to external injury; at other times, it takes place without any assignable cause. It usually betrays a malignant character, proceeding, if allowed to remain, to ulceration, and returning, sooner or later, when extirpated.

Scirrhous and *encephaloïd* are also extremely infrequent. Indeed, so seldom do these heteroclitic formations occur in the muscular system, that it has hitherto fallen to the lot of few pathological anatomists to observe them. The diagnosis of their tumors is often obscure, and difficult of determination. *Scirrhous*, it should be remembered, generally makes its appearance in old persons, whereas *encephaloïd* is rarely seen after the age of thirty. Much assistance may also be derived from the form and consistence of the morbid deposits. A scirrhouous tumor is pretty regularly circumscribed, hard, and almost incompressible; an *encephaloïd* one, on the contrary, is generally lobulated, firmer in some parts than at others, doughy, and somewhat inelastic: the growth of the one, moreover, is usually very slow, and attended with darting, lancinating pain; that of the other is almost always rapid, unaccompanied with much local uneasiness, and remarkable for its great bulk. When the ulceration takes place, the scirrhouous tumor gives vent to a thin, ichorous, irritating discharge; the sore is deep, and the edge hard and inverted: the *encephaloïd* swelling, on the other hand, throws out a soft, fungous excrescence, and is the seat of frequent hemorrhages.

On the whole, it appears extremely doubtful, whether any

of the heterologous formations are ever seated, in reality, in the muscular substance. In all probability they are originally developed in the interstitial cellular tissue, from whence, as they augment in volume, they gradually encroach upon the fleshy fibres, displacing them, altering their texture, or even producing their entire absorption. On this point, however, I am not prepared to deliver a positive opinion; nor do I know any person that is. Professor Warren, of Boston, who has written one of the most excellent treatises on tumors extant, has given us no information which enables us to solve this question; and I am fully persuaded, from all that can be gathered on this subject, that further observation is necessary before we can arrive at any definite and satisfactory conclusion concerning it.

Hypertrophy of the voluntary muscles is extremely infrequent, and has hitherto been noticed chiefly in the tongue, where, as will be shown hereafter, it is occasionally congenital. As occurring from the influence of inordinate exercise, and the unusual influx of blood, the best example is that which takes place in the muscles of the arm of the blacksmith, and in the leg of the rope dancier. Muscles that have experienced this change, whether it be the result of accident, or purely physiological, are of a deep red color, firm, tough, and comparatively little compressible, with a bulk greatly exceeding what is observed in the normal state.

A more common affection is *atrophy*, or unnatural diminution of volume. It may arise either from general disease, such as phthisis, carcinoma, or dropsy, or from local difficulty, as inflammation, ordinary palsy, or defective nutrition. Indeed, whatever has a tendency to impair the function of innervation, retard the circulation of the blood, or produce permanent inactivity, may be considered as so many causes which are followed, sooner or later, by atrophy of the voluntary muscles. Hence this lesion is generally associated with palsy, whether proceeding indirectly from disease of the cerebro-spinal axis, or directly from the injury of the nerves supplying the affected part. The muscles around luxated joints, especially those of the hip and shoulder, are often atrophied, simply, it would appear, from want of exercise.

The extent to which the wasting of the muscles proceeds is various. Frequently they are reduced to mere membranous bands, pale, flaccid, and almost devoid of irritability; and, in some rare instances, their fibres are entirely absorbed, a dense cellular substance being all that is left in their place.

In persons dying of protracted diseases, I have repeatedly observed a dark bluish color in particular muscles, especially those of the abdomen, accompanied with remarkable flaccidity and facility of laceration. These changes are more common in negroes ; and, from having often noticed them within a few hours after death, I am disposed to think that they are not altogether cadaveric. Dropsical and consumptive subjects, more frequently than any other, present these appearances.

The voluntary muscles are occasionally infested by parasitic animals, the principal of which are the cysticercic hydatid, and the spiral trichina. The former are seldom seen in the human subject, but are very common in the swine, sheep, and other quadrupeds, in which, particularly in the first, they often exist in immense numbers, rendering the flesh completely unfit for use. The *spiral trichina*, (Figs. 12, 13, 14,) which has been recently discovered by Mr. Richard Owen, a distinguished English naturalist, is a very delicate, minute, coiled-up entozoon, about the twenty-fourth of a line in length, and the seven hundredth part of an inch in diameter. It is of a cylindrical shape, and terminates obtusely at both extremities, which are of unequal size, the larger being furnished with a transverse linear orifice, which evidently answers the purpose of a mouth. It is a singular fact that this worm is always enclosed by a distinct cyst, which is the reason, probably, why it so long escaped the observation of anatomists ; since it appears, from the researches of Owen, Knox, Hodgkin, and others, that its occurrence is rather frequent than otherwise. This cyst, which is supposed by some to be merely condensed cellular tissue, is formed out of the plastic lymph of the blood, and is scarcely one fortieth by one hundredth of an inch in diameter. It is of a whitish appearance, and

Fig. 12.*



Fig. 13.†



Fig. 14.‡



* Cysts of the spiral trichina in situ, natural size.

† Separate cyst, containing the trichina magnified.

‡ The animal magnified : *a*, the head ; *b*, the tail ; *c*, the body.

of an oblong shape, with one extremity so contracted as to form a short, imperfect neck.

Amongst a collection of trichinas, it is by no means uncommon to find some which have lost their vitality or been entirely removed by absorption. In such cases, the enclosing cyst is usually collapsed, more or less opaque, or even ossified, like that of a dead hydatid. It is probable that these parasitic animals enjoy^s but a very brief existence, though, upon this point, we have no satisfactory information. Generally there is only one in each cyst, but, in some instances, there are two, or even three. They are developed in the interfibrillar cellular tissue, and appear to be wholly confined to the muscles of voluntary motion, together with the tendinous structures immediately connected with them. Their number is sometimes immense, the flesh being every where studded with them. The presence of these worms in the system appears to be unconnected with age, sex, or any particular form of disease.*

Under the name of *muscular apoplexy*, M. Cruveilhier, of Paris, has recently described a very singular disease, which, notwithstanding its great infrequency, is deserving of brief notice in this place. The lesion appears to be most common in scorbutic subjects, or in persons of a weak and lax fibre, with a thin and watery state of the blood. It has likewise been noticed in people affected with intermittent fever, delirium tremens, and phlegmonous erysipela. No muscles, not even the heart, are exempt from this effusion; but, according to the author above quoted, the straight muscles of the abdomen are more frequently and extensively affected than any other. The number of apoplectic depôts is extremely variable. In some instances there are only a few, whilst in others there are several dozens. They are at first of a dark color, and soft consistence, but, by degrees, they become lighter, and acquire greater lividity, resembling, in these respects, the apoplectic depôts of the cerebral tissue. In volume, they range between that of a pea and a hen's egg. The muscular texture immediately around these collections is more or less lacerated, and infiltrated with blood.

M. Cruveilhier thinks† he has conclusively proved that these sanguineous effusions are dependent upon phlebitis. By injecting ink, diluted with water, into the femoral veins of

* London Cyclopædia of Anatomy and Physiology, p. 115.

† Dict. de Medicine et de Chirurgie Pratique, t. iii. p. 288.

dogs, he found, in a few days, all the muscles of the corresponding limb studded with clots of blood, which had evidently been deposited in the midst of the lacerated fibres. In such of the animals as survived from four to eight weeks, cicatrices were discovered, entirely similar to those that are sometimes seen in the brain. These experiments require to be repeated and modified before we can venture to deduce any positive conclusions from them.

As being next in order, we may speak of the lesions of the tendons, the aponeuroses, and synovial bursa, inasmuch as these organs are all more or less intimately connected with the muscles, as well as closely allied to each other in structure and function. A rapid outline, embracing the more important facts relative to the general and pathological anatomy of these textures, is all that will be attempted in the present chapter. They will be considered in the order in which they have been enumerated.

SECTION II.

Of the Tendons.

THE appearance of the *tendons* must be familiar to every one. They are a set of white, elongated bodies, which serve, on the one hand, to receive the muscular fibres, and, on the other, to connect them with the bones, ligaments, and cartilages. In regard to their shape, some are rope-like, others membranous; and, in most situations, they are enclosed by strong sheaths, the inner surface of which is lined by a synovial structure, to facilitate their gliding movements. The connection between the tendons and muscles is so intimate that it is impossible to sever it, except by protracted boiling and maceration. It was owing to this circumstance that some of the older anatomists were induced to assert the real identity of these organs; the only difference depending, as they alleged, upon the greater density of the one over that of the other.

The tendons consist of white, glistening fibres, the tenacity of which exceeds that of almost every other animal tissue: they lie close and parallel to each other, and they are tied together by condensed cellular substance. No nerves

have been traced into the tendons, and in the normal state they are perfectly insensible. Their vessels, although small, are perfectly injectable, notwithstanding the reverse is usually asserted by anatomists. A few years ago I was shown a beautiful specimen of the tendo-achillis of a child, in the cabinet of Dr. Mott, of New York, the arteries of which were so completely filled with size, colored with vermillion, that the whole exhibited quite a florid appearance. A similar preparation is contained in my own collection. Immersion in spirits of turpentine, by rendering the tendinous structure more transparent, shows the distribution of the vessels to great advantage.

The basis of the tendinous texture is gelatine, which is readily extracted by boiling. It is destitute of elasticity, as well as of extensibility, and is therefore well calculated to transmit to the bones the action of the muscles; in the accomplishment of which purpose — the principal one it has to fulfil — its operation appears to be wholly mechanical.

The tendons, as before stated, are embraced and fixed in their place by fibrous *sheaths*, the internal surface of which is lined by a synovial membrane, and constantly lubricated by a sort of oily halitus. Externally they are rough, and united to the surrounding parts by lax, cellular substance. These envelopes are very strong, thick, especially on the dorsal surface of the leg and fore-arm: some of them contain several tendons, and they are composed of aponeurotic fibres, closely interwoven with each other. Their organization is similar to that of the tendons.

Professor Mayo * has made a number of experiments, which show that the extremities of tendons which have been divided readily *reunite*, through the intervention of a firm, tough substance, which gradually assumes all the properties of the original texture. During the first few days, this matter is very soft, and of a red color, from the admixture of the blood that is poured out in the operation. By and by, it augments in density, becomes slightly elastic, and adheres more or less tenaciously not to the cut ends only of the tendon, but likewise to its fibrous sheath, which is discolored for some distance from the wound. Towards the end of the third week, the extravasated blood is entirely absorbed, and the new substance, which is now of a pale grayish complexion, is found diminished in thickness, but increased in firmness, and to be

* Outlines of Human Physiology, p. 477, fourth edition.

inseparably coherent with the original structure, to the properties of which it ultimately assimilates itself.

When these bodies are destroyed by gangrene, it is probable that they are never entirely regenerated. I am not ignorant of the remarkable example related by Dr. Baronio, an Italian physician, of the reproduction of the whole tendon-achillis; but such instances are extremely rare, and, at best, of a very doubtful character.

From what is known concerning the organization of the tendons, it might be inferred that they are not very prone to inflammation; and such, indeed, experience has shown to be the fact. The disease, in most cases, arises spontaneously from the influence of the syphilitic poison, the operation of mercury, or from the effect of atmospheric vicissitudes. Its march, under these circumstances, is generally of a chronic nature, the most important alterations which it induces being hypertrophy and induration of the affected part. Conjoined with these changes are usually certain morbid appearances of the fibrous sheaths, such as infiltration of its external cellular texture with a greenish jelly-like fluid, thickening and opacity of the lining membrane, and effusion of yellow turbid synovia. Purulent matter is sometimes poured out; and the tendinous structure may be so much altered as to become unfit for its functions.

The process of *acute inflammation* is most distinctly seen in wounds, sprains, and whitloe. The tendon loses its natural polish, assumes a faint reddish color, from the engorged state of its capillaries. At a more advanced stage, lymph is poured out, either alone, or mixed with serum and blood; and, in violent cases, suppuration occasionally sets in; but this, I presume, is very rare. When the inflammation has attained its height, the tendon is of a pale ash-color, soft, pulpy, and considerably thickened.

Inflammation readily deprives the tendons of their vitality,—a circumstance which is not surprising when we consider their feeble and imperfect organization. Whole cords are sometimes destroyed by this disease, which nature always attempts to eject from the system by setting up the process of ulcerative absorption around the dead substance: the work of separation is usually very tedious, and resembles a good deal the exfoliation of a necrosed bone. In this state, the tendons lose their glistening lustre, assume a dull grayish aspect, and become thick and doughy; the individual fibres, however, retaining,

in some degree, their original consistence. This occurrence most frequently happens in the fingers and palms of the hand in what is called whitloe,—one of the most painful and distressing affections to which these textures, in common with some others, are liable.

Ossification of the tendons is much less common in man than in the inferior animals. Birds are very liable to it; and it is also frequently observed in the horse, sheep, goat, and ox. The change is most common in the tendons of the foot in old subjects, where they slide over, and rub upon the bones.

Atrophy is likewise very rare, and is only observed in connection with great wasting of the muscular texture. Inordinate enlargement occurs principally as an effect of chronic inflammation. I am not aware that any of the heterologous deposits ever take place either in the tendons, or in either of the other structures included in the present chapter.

The sheaths of the tendons, like other serous structures, are subject to *dropsical accumulations*. The bags thus formed are generally of an ovoidal shape, and vary in size, from that of a pea to that of an apricot. Their contents are usually of a glairy viscid character, like the white of eggs, though, in this respect, there is considerable diversity in different cases. Sometimes, along with the fluid, the sac contains a number of loose bodies, similar, in all respects, to the concretions found in the movable joints and the synovial bursa. They are of a pale yellowish color, tough consistence, frequently shaped like gourd-seeds, and of variable size, from that of a grain of wheat to that of a bean.

This disease constitutes what, in surgical language, is called a *ganglion*. A difference of opinion has existed in regard to the nature of this affection, the question being, whether it is of new formation, or merely a succulated expansion of the serous lining of the tubular structure in question. For my own part, I have no hesitation in saying, from what I know respecting this lesion, that the former opinion is entirely gratuitous, not having the slightest foundation in truth. The disease occurs most frequently at the wrist, along the extensor tendons. Females are more subject to it than males, especially such as are much engaged in hard manual exercise. It is likewise very common in horses, in which it is known by the name of wind-galls.

SECTION III.

Of the Aponeuroses.

THE aponeuroses are fibrous membranes, which bind down and enclose the muscles, at the same time insulating them from each other. Their arrangement is that of sheaths, which encase the extremities, and thus serve to prevent any displacement of the organs they envelope. Externally they are rough, flocculent, and in contact with cellulo-adipous matter: internally they correspond to the muscles, to which they are loosely united in some places, but very firmly in others. Generally speaking, these structures consist of a single layer, the thickness of which is proportionate to the volume and strength of the bodies which they enclose. They are very sparingly supplied with vessels, nerves, and absorbents; and, in the normal state, they appear quite insensible.

The aponeuroses, possessing the same organization as the periosteum, dura mater, and pericardium, are liable to the same diseases. *Acute inflammation* is very rare, and observed principally as the result of external violence, whitloe, and anthrax. Gout and rheumatism are supposed to have their seat exclusively in the fibrous envelopes of the extremities, but of the truth of this opinion many physicians still entertain serious doubts. My own idea, which coincides with that of Scudamore, is, that the aponeurotic, ligamentous, tendinous, and bursal textures are all implicated in nearly the same degree, the diseases here referred to sometimes beginning in the one, sometimes in the other, but sooner or later attacking the whole of them. But upon these subjects we stand in need of further and more substantial information.

In *chronic inflammation*, which, by the way, is much more common than the acute form of the disorder, the aponeuroses become thickened, preternaturally hard, and of a pale yellowish color, interspersed with grayish, leaden, or brownish patches. Spicules of bone sometimes sprout from them, which occasionally acquire quite a large size, and exhibit the appearance of so many stalactites. Another effect of chronic irritation, likewise very rare, is extreme attenuation of these membranes, constituting a sort of real atrophy. This result is

generally produced by the pressure of a tumor, which, exerting its detrimental influence for some time, by degrees causes the absorption of the aponeurotic fibres. Inflammation of these structures manifests little disposition to pass into suppuration, gangrene, or ulceration ; and the heterologous deposits are, I believe, entirely unknown in them.

SECTION IV.

Of the Synovial Burses.

THE *synovial burses* are small semi-transparent sacs, filled with a thin unctuous fluid, which are situated about the joints, especially those of the extremities. For the most part, they lie between the bones and tendons, or between tendon and tendon, or finally between the bones and skin. Nearly one hundred and fifty of these pouches are to be found in different situations of the body. Their structure is perfectly identical with that of the synovial membranes of the joints, being, like them, resolvable by maceration into cellular substance : they are sparingly supplied with vessels and nerves, possess little sensibility in the sound state, and are constantly lubricated by a thin oily fluid, which thus enables them to facilitate the motions of the parts between which they are situated, and which seems to be their principal office. Thus constituted, the synovial burses are liable to inflammation, suppuration, thickening, and cartilaginous degeneration.

One of the earliest effects of acute inflammation is an increase of vascularity,—the redness here, as in the other serous structures, appearing at first in separate lines, which at length coalesce and thus assume an arborescent arrangement. In some instances, the redness has a dotted form, or there are small ecchymoses, caused by the rupture of one or more capillaries. The synovial membrane loses its transparency, and presents an opaque, milky aspect, being as yet little or not at all thickened. When the disease is at its height, the natural secretion is partially suspended, which, however, lasts only for

a short time, when it not only augments in quantity, but is likewise changed in quality. Instead of being thin, oily, and transparent, it takes on the appearance of a brownish turbid serum, mixed with flakes of lymph, pus, or even small clots of blood. The tumor which is thus formed is sometimes as large as a cocoanut, but generally it does not exceed the size of a walnut, an orange, or a goose's egg: in most cases, it is somewhat rounded, elastic, and painful on pressure, the skin covering it being red and hot. The abscess may open externally, or the sac may burst, and the matter be effused into the surrounding cellular tissue. I have, in a few instances, found these tumors filled with a fluid of the color and consistence of currant jelly.

When the disease is *chronic*, the effused fluid is sometimes loaded with loose concretions, of a dense semi-cartilaginous consistence. They are of a light brownish color, and of a flat oval form, not unlike melon-seeds. Their numbers are occasionally quite great, upwards of fifty having been extracted from a single bursa. How are these bodies produced? Sir Benjamin Brodie supposes that they are merely masses of plastic lymph originally poured out in soft, amorphous flakes, which by degrees become firm, and assume a determined shape by the pressure of the surrounding parts. This is one way of accounting for them; another is to suppose that they originally grow from the inner surface of the sac, from which they are at length detached by friction, like the little tumors which are sometimes met with in the movable joints.

Bodies closely resembling *hydatids* are sometimes found in the synovial bursas. In a case, the particulars of which were detailed a few years ago by Professor Cloquet, of Paris, there were upwards of one hundred and forty of these substances, varying from one to three lines in diameter, nearly transparent, and of a lenticular shape, in a large pouch between the great trchanter and the tendon of the great gluteal muscle. More recently he has met with them in an accidental cyst, near the insertion of the tricipital muscle of the arm, and also in the sheath of the tendon of the long palmar muscle.

In protracted cases of this disease, the sac is very apt to become *hypertrophied* and indurated. Sir Benjamin Brodie has seen it more than half an inch in thickness, with a small

central cavity filled with synovial fluid. In the horse I have repeatedly seen it converted into a hard gristly substance; and the same phenomenon has often been witnessed in the human subject. Cases are even recorded, where it is said to have partaken of an osseous character. Not unfrequently the inner surface of the sac exhibits a honey-comb appearance, the shreds of lymph intersecting each other in various directions. In other instances, however, though the inflammation has persisted for a long time, the membrane retains nearly its primitive structure.

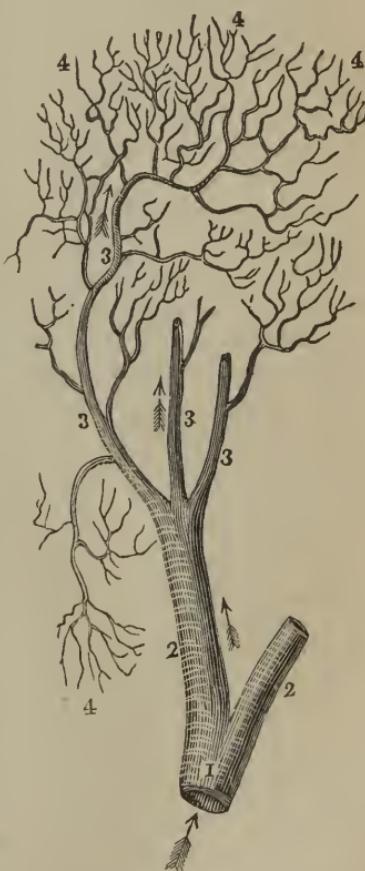
CHAPTER V.

Of the Arteries.

Their Tunics. — Nutrient Vessels. — Nerves. — Cellular Sheath. — Lesions. — Wounds. — Inflammation. — Suppuration. — Ulceration. — Aneurism. — Contraction. — Hypertrophy. — Morbid Deposits.

THE arteries distributed through the various organs and textures of the animal fabric (Fig. 15) are composed each of three cylindrical coats, differing from each other materially in their structure and functions. The external one, decidedly the most important of the three, is of a white grayish color, and made up of dense cellular substance, the filaments of which, although closely matted together, follow no assignable course. It is highly tenaceous, extensible, and elastic, and therefore well qualified to resist violence, and slide out of the way of injury. Its firmness is so great, that it is not easily divided by the ligature; and, in cases of disease, it often preserves its integrity long after the other tunics are destroyed, or, at all events, very much altered. In old, corpulent subjects, this membrane is sometimes the seat of a small quantity of adipous matter; but it does not appear

Fig. 15.*



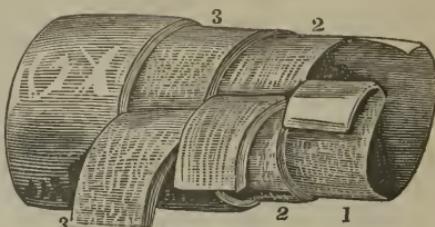
* Mode in which an artery separates into its ultimate branches: 1, trunk of the vessel; 2, large branches into which it subdivides; 3, small branches diminishing gradually in volume until they become capillary, — 4.

to be liable, like the same structure in other regions of the body, to serous infiltration, owing, doubtless, to the peculiar mode of aggregation of its component filaments. (Fig. 16.)

The *middle tunic*, supposed at one time, though erroneously, to be muscular, contains the peculiar tissue which imparts to these tubes their characteristic attributes. It is composed of dense, yellowish, buff-colored fibres, arranged spirally around the caliber of the vessel, none of them forming complete circles, but rather segments, which are joined so as to produce rings. United together by short cellular substance, these fibres are proportionally stronger in the smaller than in the larger trunks, in the latter of which they can be separated into a number of lamellæ, varying in thickness and density, according to the artery in which they are examined. Thus constituted, the middle coat is firm, solid, and elastic, yet withal so brittle that it is readily divided by the ligature. Its thickness exceeds that of the other membranes, and its extensibility is much greater in the longitudinal than in the transverse direction. Viewed in reference to its structure, it may be considered as forming a sort of connecting link between the cellular and yellow fibro-elastic tissues, combining the strength of the former with the astonishing elasticity of the latter. No fibrin, the proximate element of muscle, has yet been detected in its substance.

The internal tunic, by far the most delicate of the three, is remarkably thin, smooth, and transparent, being designed, apparently, not so much to give strength to the arteries as to furnish their interior with a polished and unctuous surface, to facilitate the movement of the blood. Lining the whole aortic portion of the vascular system, it passes through the left chambers of the heart into the four pulmonary veins, which it supplies in their entire extent, but is not continued into the pulmonary arteries. This membrane, from its great fragility, readily yields under the ligature, and is not sus-

Fig. 16.*



* Coats of an artery separated from each other: 1, the internal membrane; 2, the middle tunic; 3, the external membrane.

ceptible, moreover, of much extension. Its inner surface is smooth, polished, and constantly bedewed by a thin, watery fluid, on which account it is customary to associate it with the serous textures. Although it presents many characters in common with these organs, it nevertheless differs from them in several important particulars, and may therefore be very properly regarded, I think, as a peculiar structure, unlike any other in the body.

In some of the arteries, the inner tunic is disposed in longitudinal, in others, as in the popliteal, in transverse plaits. The latter are always very conspicuous in lacerated wounds, and they are supposed, by Mr. Guthrie, to perform a very important part in the suppression of hemorrhage. No valves are formed by this membrane, except at the mouth of the aorta, where it is arranged into three duplicatures, at the free margin of which is a peculiar fibro-cartilaginous body, styled the corpuscle of Aurantius. These valves will be described more particularly in another page.

These different tunics are cemented together by cellular matter, and they are not only liberally supplied with proper nutrient vessels, but likewise with nerves and lymphatics. None of these structures can be traced beyond the subserous cellular tissue; but, that they extend into the internal membrane, is abundantly proved by its capability of undergoing the various processes dependent upon inflammation, to say nothing of the fact of its free surface being the seat of a constant secretion in the normal state. The nutrient vessels can be easily demonstrated by artificial injection, and they are generally very conspicuous in the larger trunks after death, especially in asphyxiated subjects. From their physiological importance, it is obvious that they should be as little disturbed as possible in surgical operations, as any violence done to them must necessarily eventuate in corresponding mischief to the parts which they supply.

The nerves of the arteries are extremely numerous, and, in many of the larger trunks, they may be seen forming a sort of plexus around them, not unlike those which encircle the oesophagus. In the splanchnic cavities they are furnished principally by the great sympathetic, but in the extremities they are entirely derived from the cerebro-spinal axis. The pulmonary arteries, besides receiving some filaments from the sympathetic, are supplied by the par vagum.

Finally, the arteries, in most regions, are enclosed by a

loose sheath of cellular substance, which has been described by some as a distinct and separate coat. By this sheath, which performs a most important character in the suppression of hemorrhage, the vessels are connected to the surrounding organs, and enabled to maintain their proper position.

Thus constructed, the arteries are liable to wounds, inflammation, suppuration, ulceration, dilatation, and contraction, hypertrophy, and different morbid deposits.

That wounded arteries possess the power of self-reparation is a fact which was long since proclaimed by Haller, Petit, and other writers of the last century; but the process by which this is effected, or the various steps which precede and accompany it, were first clearly pointed out by Dr. Jones, of England, about thirty years ago. Convinced that a question of so momentous a character could only be determined by carefully interrogating nature, he instituted a series of the most laborious experiments upon the inferior animals, such as the horse and the dog, from which he deduced the conclusion, since so abundantly confirmed by the researches of other physiologists, that the immediate effect of the division of an artery is an impetuous flow of blood, attended by a forcible retraction of the vessel within its sheath, and a slight annular contraction of its extremity. The canal of the sheath is now closed by the formation of a coagulum, blood being at the same time effused into the surrounding cellular substance. The next step in the process is the concretion of the fluid within the divided vessel, generally as high up as the nearest collateral branch. The stopper thus formed is commonly of a slender conical shape, with the apex directed towards the heart. It is seldom sufficiently large to constitute a perfect plug for the vessel, nor does it at first adhere very firmly to its internal surface, excepting at its base, where it is also closely united with the outer coagulum. The connection between the two clots, and the relation which they sustain to the orifice of the divided artery, have been felicitously compared by Beclard to the mouth of a bottle, closed by its stopper, and spread over with sealing-wax.

Soon after these coagula have formed beneath, around, and within the divided artery, the different tunics, taking on inflammation, pour out plastic lymph, which serves still further to seal up the orifice of the vessel, and to strengthen the connection between it and the clotted blood. The absorbent vessels of the parts are also actively engaged carrying away,

at first, the more attenuated, and afterwards the more solid elements of the coagula, until the whole mass is finally transformed into a dense grayish cord, in which it is difficult to discern any trace of the original textures. The period required for the perfection of these changes varies in different cases, depending upon the volume of the vessel, the nature of the wound, and the constitution of the patient.

Such, in few words, is the process employed by nature in arresting hemorrhage from a divided artery. Similar phenomena, very nearly, take place when a vessel of this kind is tied with a ligature, except that there is no external coagulum. The internal clot is also generally more complete ; and, as the serous and fibrous membranes are usually cut through, the inflammation is apt to run much higher, the different coats being often rendered extremely vascular and pulpy. The ligature is either removed by absorption, or, as is more frequently the case, it remains until the outer tunic is destroyed by ulcerative action ; which, when the artery is small, usually happens in eight or ten days, but, when large, not under several weeks. In whatever way an artery be obliterated, the collateral vessels, as they are termed, are always permanently enlarged, compensating thereby for the lost power on the part of the main trunk. Thus, by the anastomoses of the vascular system, and by the happy contrivance here alluded to, the Creator has provided the means of carrying on the circulation, even after the stoutest branches are completely closed up.

When an artery is wounded longitudinally, or to a small extent obliquely, either an aneurism is formed, or the breach is repaired by adhesive inflammation. The same consequences follow when an artery is punctured with a sharp-pointed instrument, or if it be divided transversely through one fourth of its circumference. If the vessel be cut across one half or two thirds, cicatrization will be impossible ; the injured tunics will either yield to their native power of retraction, or they will be destroyed by ulceration. In either case, the final restoration is effected in the same manner nearly as when the vessel is cut across in the first instance.

When an artery is forcibly lacerated, it is much less apt to bleed profusely than one that is divided by a transverse cut. Cases occur where whole limbs, involving of course the largest arteries, are torn from the body, and yet scarcely any blood is lost. The retraction and annular constriction are

always much greater here, and the coagula also much larger, as well as more rapidly formed, than under opposite circumstances ; and these occurrences, added to the ragged state of the inner and middle coats, and the exhausted condition of the patient, as must always happen in such severe accidents, afford a speedy and effectual barrier to the emission of blood.

Acute arteritis is generally induced by external injury, or by an extension of disease from the adjoining structures. Nevertheless, it would seem occasionally to exist as an idiopathic affection, or to come on without any assignable cause. Restricted in the majority of instances to one or more of the larger trunks, it not unfrequently involves the smaller branches, and sometimes even the capillaries. Occasionally the disease appears to be almost universal, pervading nearly the whole arterial system. In a man forty years of age, Dr. Bade, a French author, observed the inner membrane of all the larger arteries thickened, and of a red color, the traces of the inflammation gradually diminishing towards the smaller branches ; and examples of a similar kind are to be found in the works of Bertin, Hodgson, and other writers.

When arising spontaneously, the disease usually begins in the internal membrane and subserous cellular tissue, from which it gradually spreads to the other tunics ; the reverse happening when it is induced by external violence. The anatomical characters of acute arteritis are redness, opacity, rugosity, and softening of the lining membrane, with an engorged, lacerable, and thickened state of the outer and middle tunics. When the inflammation is severe, the parietes of the affected artery are generally remarkably pulpy, and so much diminished in consistence as to be easily torn or divided by the ligature. The nutrient vessels are loaded with blood, and often exhibit a real varicose aspect, their ultimate twigs ending apparently in the subserous cellular substance. With regard to the redness of the internal membrane, it is liable to considerable diversity ; but, generally speaking, it occurs in small patches, which are diffused over a considerable extent of surface, and which vary in diameter between that of a split pea and a five cent piece. In intensity it ranges from a light pink to a deep scarlet, through numerous intermediate shades of lilac and purple. In some instances the redness is uniform. With this change of color are always associated important alterations of texture. The inner membrane, as was before intimated, losing its smoothness and polish, as-

sumes a rough fleecy aspect, and, owing to the softened state of the subserous cellular tissue, is easily detached from its natural connections. Globules of lymph, either alone or blended with pus, occasionally adhere to its inner surface ; and, in the larger arteries, it is not uncommon to meet with well-developed pseudo-membranes, similar in all respects to those of the serous textures of the splanchnic cavities. The other tunics are also seriously affected. They become moist, tumid, friable, and transformed frequently into a reddish homogeneous mass, almost void of cohesive power. Their elasticity, naturally so great, is partially lost, and in many instances they are freely infiltrated with serosity, sanguinolent fluid, or even pure pus.

Patches of a scarlet, purple, or brownish color, caused by the imbibition of the blood, are sometimes observable on the inner coats of the arteries after death, which Corvisart and some others have supposed to be the result of inflammatory irritation. They are most conspicuous on the under surface of the vessels, or where there is the greatest amount of blood accumulated, and they are frequently witnessed in persons who die of pulmonary phthisis, putrid fever, apoplexy, and malignant cholera. The redness thus produced exhibits the appearance as if it were dyed into the very substance of the lining membrane, and it commonly exists in stripes, small specks, or geometrical figures, having an abrupt termination : that, on the other hand, which results from irritation generally loses itself by insensible degrees, nor is it diffused over so large an extent of surface. But, be this as it may, no difficulty can possibly arise upon this subject, when it is remembered that the inflammatory discoloration is constantly associated with important lesions of the arterial tissues. The cadaveric redness always appears much sooner in warm than in cold weather, and may be produced at pleasure by steeping a vessel for twenty or thirty hours in fluid blood, at a moderate degree of heat.

Chronic arteritis is probably a much more common affection than the great silence of the profession respecting it would lead us to infer. Like the acute form of the disorder, it is much more frequently observed in the large than in the small arteries, and hitherto has been noticed chiefly in persons who have died of lesion of the heart, or who have been constitutionally affected by mercury, syphilis, or scurvy. The most prominent feature of chronic inflammation is

thickening of the several coats of the artery, which, in protracted cases, may amount to such a degree as to encroach materially upon its caliber. The nutrient vessels are not much injected, and the redness, so conspicuous in the acute variety of the disease, is rarely present in this. The lining membrane, on the contrary, is of a yellowish, dusky, brownish, or grayish tint, interspersed frequently with bluish spots, which thus give it a mottled appearance. All the tunics are abnormally thickened, dense, and brittle, possessing little elasticity or cohesive power. Patches of fibrin are often observed upon the inner surface of the vessel; and, in many instances, the lining membrane is considerably puckered, cracked, or even forced out of its natural situation. The various deposits, presently to be noticed, are all caused, probably, by chronic inflammation.

Although *suppuration* is seldom spoken of by pathologists as an attendant on arteritis, yet I am inclined to believe that it is much more frequent than is commonly imagined. The matter being generally poured out upon the inner surface of the vessel, is swept away by the circulating current as fast as it is secreted, which is the reason, doubtless, why it is not oftener noticed after death. Sometimes, however, it is entangled in the substance of the false membranes, infiltrated into the arterial tunics, or collected into small points between the inner and middle membranes. In a case observed by Andral, the serous lining of the aorta was elevated into half a dozen abscesses, each as big as a small nut, and filled with phlegmonous pus. Arteritis is, on the whole, much less liable to terminate in suppuration than phlebitis, in which respect the one resembles inflammation of the serous membranes, the other of the mucous.

Ulceration, although a frequent consequence of chronic irritation, is seldom witnessed in the acute form of the disease. Manifesting a peculiar predilection for the larger trunks, it commonly commences in the serous membrane, from which it gradually extends to the middle and outer tunics until it leads to complete perforation. Such a termination, however, must be regarded as extremely rare. The ulcers, which are extremely irregular in respect to their form, vary very much in their size, number, and general characters. At times they are very small, scarcely exceeding the diameter of a mustard-seed; but, in the plurality of cases, they are as big as a split pea, a five cent piece, or even a guinea. Their margins are

usually ragged and irregular, considerably elevated, but seldom injected; and their bottom, which is rough and uneven, is commonly formed by the middle tunic, the fibres of which frequently present a shreddy, lacerated appearance. In many instances, the erosions look like so many fissures, cracks, or chops, with sharp prominent, and irregular borders. This form of the disease is by no means uncommon, and is ordinarily associated with, or rather, dependent upon, the calcareous deposit. The number of ulcers is seldom considerable, though in a few rare cases the inner surface of the larger trunk has been found completely checkered with them. When confined to the internal tunic, M. Bouillaud thinks that they sometimes admit of cicatrization,—an opinion in which I am disposed to coincide, from having seen several examples of ulcers of the aorta which had obviously been partially repaired.

The arteries may be said to be insusceptible of *gangrene*. Their conservative energies, as stated on a former occasion, are surprisingly great, and thence they often escape destruction in the midst of parts that are perfectly deprived of vitality. In such cases, their outer surface becomes incrusted, at an early period of the disease, with a thin layer of fibrin; and, long before the deadened textures begin to separate, the blood coagulates in their interior, and thus opposes an effectual barrier to the occurrence of hemorrhage.

Another deposit, which I have occasionally observed, is the *tubercular*. This affection, I have reason to believe, is extremely rare in this country, but appears to be very common in Europe. It usually begins in the cellular substance which connects the inner and middle tunics, in small isolated points, of a pale yellowish color, greasy to the touch, and of a semi-concrete consistence. As these points augment in size, the inner membrane of the tube is forced beyond its natural level; and, if many of them chance to be seated together, they often become confluent, forming thus irregular patches, which in some instances pervade the whole surface of the vessel. After having remained stationary for a while, the heterologous deposit manifests a disposition to soften, and, in process of time, is converted into a pliable, curdy substance, having all the properties, both physical and chemical, of scrofulous pus. Resulting, probably, always from slow chronic irritation, this lesion is usually accompanied by the calcareous formation, and is most frequently witnessed in strumous subjects.

Though the quantity of tubercular matter is seldom great, its tendency is uniformly to impair the elasticity of the vascular tunics, and to dispose them to ulcerative action. The most common seats of this disease are the bifurcations of the arteries, though it is by no means confined to these localities.

The disease of which I have thus given a rapid outline has generally been described by European writers under the vague name of the *atheromatous deposit*. The term which I have here substituted is, I think, altogether preferable, as it designates at once the true nature of the lesion in question. But it may be objected, perhaps, that the deposit is not in reality of a tubercular nature, and that, therefore, the name is equally unphilosophical as the other. To this I reply that there is nothing to justify such a conclusion, inasmuch as the physical properties of this substance, its mode of secretion, and its final conversion into purulent fluid, all conspire to show its identity with tubercular formations in other textures of the body.

Much less frequent than the deposits now described are the melanotic and encephaloïd. These, in fact, are among the rarest affections of the arterial tissue, and, with the exception of several cases reported by Cruveilhier, Carswell, Velpeau, and Otto, no authentic information whatever is to be found concerning them. I have never met with an example of either. When occurring in this situation, the melanotic matter is usually deposited into the subserous cellular substance, in the form of minute dots, or in that of small irregular patches. The encephaloïd matter, on the contrary, although it is occasionally seated in the same locality, more frequently occupies the interior of the artery, assuming an arborescent arrangement, and filling up its caliber.

Occasionally we find deposits of *cartilage*, either alone, or as is more generally the case, in association with calcareous or tubercular matter, being either of them the result, probably, of chronic irritation. Most commonly they are limited to the inner membrane of the arteries in the connecting cellular substance of which they appear to be developed, in the form of irregular isolated patches, of a whitish, yellowish, or grayish aspect. Not unfrequently, however, they implicate all the tunics, occupying the vessel to such an extent as to convert it into a firm, inelastic tube. Writers are by no means agreed in regard to the question, whether this matter is origi-

nally deposited in the form of cartilage, or simply in that of fibrin. The result of my own researches would lead me to adopt the former opinion.

The most common morbid affection of the arteries, by far, is the deposition of *calcareous matter*. It is particularly frequent in old people, after the sixtieth year; but no period of life, except early infancy, is exempt from it. Young found it at fifteen months; Wilson at three years, and Andral at eight. The arteries most commonly implicated are, according to my own observations, the thoracic aorta, the femoral, tibial and fibular, splenic, spermatic, iliac, cardiac, and radial. The deposit is very frequent in the cerebral arteries of old persons, and there is much reason to believe that it often lays the foundation of the apoplectic effusions so common at this period of life. The carotid, subclavian, brachial, hypogastric, hepatic, mesenteric, and stomachic arteries are seldom ossified. In the pulmonary artery, this degeneration is so rare that Bichat was induced to affirm the impossibility of its occurrence. The observations, however, of Morgagni, Stoll, Lobstein, Otto, and others, abundantly show that this assertion is too sweeping. Instances occur where there seems to be a peculiar ossific diathesis, almost all the arteries in the body being rendered bony. Of this I witnessed an extraordinary example in 1834, in a man sixty-five years old, in whom not only the larger trunks, but all the muscular twigs, were transformed into rigid, inelastic cylinders, blunting the knife at every incision. Similar cases have been seen by Riolan, Harvey, Loder, and other authors.

The calcareous matter exists in various forms; sometimes in small grains and nodules; sometimes in scales, plates, and patches; and sometimes in complete rings, which encircle the vessel, and convert it into a firm, inflexible tube, totally devoid of its normal attributes. In the incipient stage of their development, these depositions often consist in minute isolated specks, of a light straw-color; and not unfrequently they are associated with other secretions, especially the atheromatous and cartilaginous. In whatever form the matter be deposited, the coats of the arteries always experience important modifications, becoming preternaturally hard and brittle, and either thickened or attenuated. These changes are generally most conspicuous in the two inner membranes, which assume a dense, wrinkled appearance, and are extremely liable to break and ulcerate, obliging thus, the outer tunic frequently to re-

ceive the whole brunt of the circulating torrent. The serous lining is often remarkably thick, dense, opaque, and transversely wrinkled.

Destitute of the usual fibrous structure of bone, the calcareous deposit differs still further from this texture in not having, in the greater number of cases, a cartilaginous matrix, in possessing no vitality, and in being always secreted in the form of a homogeneous mass, without any definite arrangement. The component elements of this substance vary in different specimens, even from the same individual; but, in most cases, the proportion of animal matter is small. In the experiments of Brande, one hundred parts were found to consist of sixty-five of phosphate of lime, and thirty-five of albumen, with some traces of gelatine; whereas, in those of Vauquelin, the animal matter formed only about one fourth, the remainder being made up of the phosphate and carbonate of lime and soluble salts. Various opinions have been entertained by pathological anatomists respecting the precise seat of this deposit; some placing it in the substance of the lining membrane, others in the middle coat, others in the cellular texture, by which these two layers are connected together. The latter of these views is borne out by the analogy which is observed in the subserous cellular tissue in other parts of the body; but, independently of this, I am disposed to adopt the opinion from personal observation, too carefully conducted, and too often repeated, to permit me to entertain the slightest doubt upon the subject. At the same time, it must be admitted that this matter may occasionally be poured out in the substance of the different tunics, otherwise we could not account for the deposition being entirely limited to the exterior of the arteries. In regard to the exciting causes of these formations, it will scarcely be going too far, to ascribe them wholly to chronic inflammation, seated in the cellular element of the arterial structure.

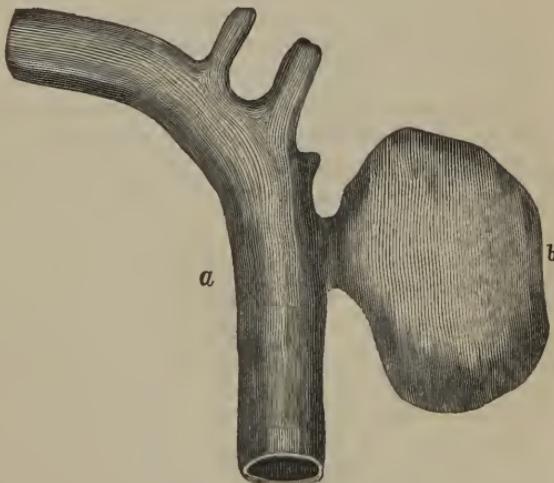
Dilatation of the arteries, constituting what, in surgical language, is termed an *aneurism*, is decidedly one of the most frequent lesions to which these interesting structures are liable. Varying in size and shape, under different circumstances, the enlargement exists sometimes at one point, sometimes at several, and sometimes is more extensively diffused, occupying the whole circumference of the tube. In the majority of instances, the disease is seated in the larger trunks; but occasionally it attacks the smaller branches, and not unfre-

quently even the capillaries. Aneurismal enlargements may be divided into four principal species,—the sacculated, cylindroid, varicose, and anastomotic. To these may very properly be added another, namely, the arterio-venous, or that form of the disease which has been described by writers, since the time of Dr. William Hunter, under the name of aneurismal varix.

When a tumor of this kind is composed of all the arterial tunics, it is called a true aneurism; if, on the other hand, it consists only of the external coat, the inner and middle being ruptured, ulcerated, or destroyed, it is denominated a false aneurism. Of these two varieties, the latter is by far the most common. Cases occasionally occur, though rarely, where, in consequence of the laceration of the fibrous membrane, the internal coat is protruded across the crevice, in the form of a hernia, which gradually encroaches upon the cellular membrane, and thus dilates it into a distinct pouch.

In the *sacculated aneurism*, (Fig. 17,) the coats of the artery are dilated into one or more pouches, occupying only a limited portion of its circumference. It occurs most frequently in the great trunks, particularly the thoracic aorta, and occasionally affects all the principal branches of the body. M. Pelletan, a French surgeon, examined an individual, in whom he discovered upwards of sixty of these dilatations; and a still more extraordinary example has recently been reported by Professor Cloquet, of Paris. In this case, the number of tumors was upwards of two hundred, the largest of which did not exceed the volume of a

Fig. 17.*



* Sacculated aneurism: *a*, the artery; *b*, the aneurismal pouch.

common pea.* There would thus seem to be occasionally a real aneurismal diathesis. Much diversity obtains in relation to the dimensions of these sac-like projections: in some instances, as we have just seen, they are remarkably small, whilst, in others, they acquire the magnitude of a large egg, the fist, or even of a mature foetal head. The manner in which they are attached is also subject to considerable variation. Very frequently they arise by a narrow foot-stalk; at other times they repose upon a broad base,—the opening between them and the artery being always much larger in the latter than in the former case.

The *cylindroid aneurism* (Fig. 18) is of an elongated spherical shape: the dilatation, which is pretty nearly uniform, embraces the entire circumference of the vessel, varying in length from a few lines to several inches. The coats are generally somewhat thickened, and the inner surface of the tube is rough, uneven, and covered with thin, irregular layers or patches of fibrin. In some instances, the dilatation is truly enormous. In a specimen of cylindroid aneurism of the arch of the aorta, presented to me by my friend Dr. W. M. Charters, of Lebanon, in the State of Ohio, the tumor measures upwards of ten inches in circumference, by five and a half in length. It formed an immense ovoidal swelling in front of the neck, which extended nearly as high up on the left side as the angle of the jaw; whilst, below, it pressed upon and destroyed the inner half of the clavicle, part of the first rib, and a small portion of the breast bone. Almost all the arteries in the body are sometimes affected with this species of enlargement. In a man, fifty years of age, Dr. Geddings, the distinguished professor of pathological anatomy in the medical college of South Carolina, found not only the

Fig. 18.†



* The subject in whom these dilatations were found was about fifty years of age. They affected every artery, almost, in the body, even the aorta and its principal divisions, but they were most numerous in the extremities. The axillary, humeral, radial, and ulnar arteries, the femoral, popliteal, tibial, and peroneal, were closely studded with them. In volume they varied between that of a millet seed and a large pea. In other respects, the coats of the vessels were perfectly healthy. (*Pathologie Chirurgicale*, par Jules Colloquet, p. 86.)

† Cylindroid aneurism: *a a*, the vessel above and below the tumor.

larger trunks, but nearly all the principal branches, dilated to at least double the normal size. The superficial temporal arteries were nearly as capacious as the main vessel of the arm, and the same circumstance was observed in the bigger branches of the brain.*

The *varicose aneurism* (Fig. 19) consists, as its name imports, in an enlarged and nodulated state of the artery, similar to that of a varicose vein. The dilatation ordinarily embraces a considerable portion of the length of the vessel, the coats of which are at the same time very thin and brittle, preternaturally light, and readily collapse when divided. In this variety of the disease, the artery is remarkably elongated, tortuous, and convoluted: the lesion seldom occurs in the larger trunks, but is most frequently observed in the secondary and ternary divisions, as the splenic, carotid, humeral, and femoral, tibial and radial, temporal and occipital.

The *anastomotic aneurism* (Fig. 20) usually described by the German pathologists under the name of *telangiectasy*, is composed of a congeries of convoluted capillary arteries and veins, dilated into a soft pulsating tumor, generally of a bright florid tint, but occasionally of a bluish, mulberry, or purple color. In some instances, it appears as a congenital disease, constituting what is called a *nævus maternus*. When of long standing, the vessels are often dilated into small sacs, and so form a truly erectile tissue, analogous to that of the penis, nipple, or wattles of the turkey-cock. Although every part of the capillary system is probably susceptible of this singular dilatation, yet the most frequent situations of anastomotic aneurism are the head, hands, and feet. In a few rare instances, it has

[Fig. 19.

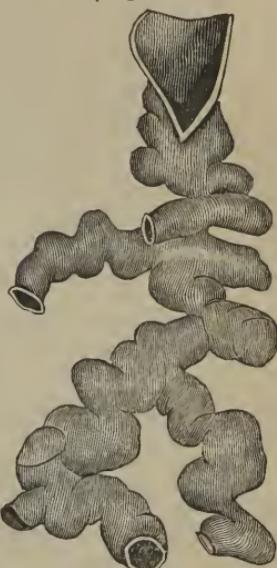
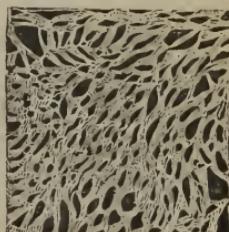


Fig. 20.



* American Cyclopædia of practical Medicine and Surgery, vol. ii. p. 413.

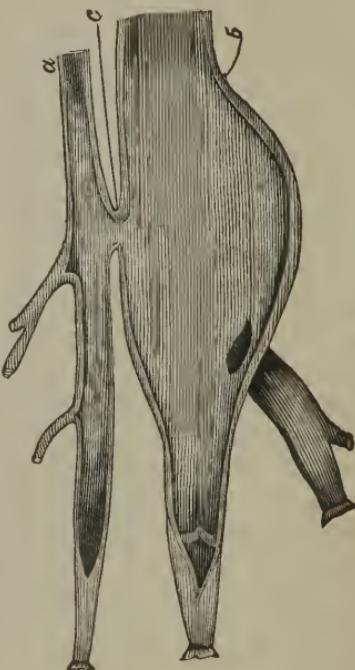
been observed on the gums and inside of the cheeks. There is a form of hemorrhoidal tumor, which, as will be subsequently shown, is probably merely a variety of anastomotic aneurism.

A tumor of this kind throbs synchronously with the heart, has a soft, spongy feel, and becomes smaller when compressed, but immediately regains its former volume when the pressure is withdrawn. Violent excitement of the heart renders it preternaturally turgid, and the same circumstance follows when there is an impediment in the venous circulation. This species of aneurism, often acquires a considerable magnitude. Its progress is not always rapid, and occasionally, indeed, it remains stationary for years. Finally, however, ulceration sets in, and, in this way, the tumor becomes the seat of frequent hemorrhages.

The fifth and last species of dilatation which I shall notice, is the *arterio-venous*, (Fig. 21,) or, as it has generally been denominated since the time of Dr. William Hunter, who first described it, *aneurismal varix*. Although this lesion is most apt to happen at the bend of the arm, where the median basilic vein lies over the humeral artery, yet it may occur in any part of the vascular system in which two considerable sized trunks of this kind are contiguous. In most instances, it follows upon the operation of venesection, but occasionally it arises spontaneously, or, more properly speaking, as the effect of ulceration.

When produced by a sharp-pointed instrument, as, for instance, the lancet, the superficial wound generally heals by the first intention; but that between the two vessels remains permanently patent, and thus allows the blood to flow readily

Fig. 21.*



* Arterio-venous variety of aneurism: *a*, the artery; *b*, the vein; *c*, the opening between them.

from one to the other. By degrees the channel here established augments in diameter, and the two vessels are either effectually agglutinated together, or their connecting cellular substance is injected with blood, so as to form a sort of globular pouch. The artery and vein, in the mean time, become sensibly altered, both as respects the size of their caliber and the texture of their parieties. The former, which now receives black blood, is gradually dilated into a soft, thin, flexuous tube, which ultimately acquires all the properties of a vein. These changes, which are always more distinctly marked in the immediate neighborhood of the preternatural aperture, frequently extend as low down as the first large collateral branch, and their invariable effect is to obscure the pulsation in the corresponding part of the limb. The vein also loses, in some measure, its normal characters. It becomes large and tortuous, both above and below the seat of the injury, acquires an extraordinary degree of density, and is no longer either so extensible or elastic. The cause of these textural changes, is chronic inflammation, leading, in the one case, to partial atrophy, in the other, to partial hypertrophy; or, in other words, what one vessel loses, the other gains.

This species of aneurism, which is generally of slow formation, seldom acquires any great bulk. Occasionally, it is as big as an egg, but ordinarily it does not exceed the volume of a common plum. It communicates to the hand which examines it a sort of jarring sensation, and to the ear a peculiar hissing sound, not unlike what would result from the prolonged articulation of the letter R, which are the pathognomonic signs of its existence.

Most of the species of aneurism here enumerated, are dependent, directly or otherwise, upon an altered or modified state of the arterial tissues. The internal and middle tunics are commonly most affected; indeed, it is rare to find them perfectly free from disease. The calcareous, cartilaginous, or tubercular deposits, noticed in a previous page, are usually present; and oftentimes the aneurismal pouch is exclusively formed of the outer coat, the other two being entirely destroyed. In the sacculated variety of the disease, as well as in some of the rest, one of the earliest effects consequent on the developement of the tumor, is the deposition of the plastic lymph of the blood, as this fluid sweeps over its inner surface. This deposition, which generally occurs in concen-

tric layers, (Fig. 22,) is sometimes remarkably abundant. Its thickness commonly varies from six to eight lines, according to the age and size of the sac, but occasionally it has been known to exceed two inches. The oldest lamellæ, or those lying directly in contact with the inner surface of the tumor, are generally of a whitish, grayish, or yellowish color, remarkably hard, dry, and brittle; whereas, those which are of recent formation, are always of a darker hue, soft, and elastic.

The occurrence of aneurism is much more frequent in men than in women, and in the old than in the young. Of sixty-three cases, recorded by Mr. Hodgson, of England, in his admirable *Treatise on the Diseases of the Arteries*, fifty-six were noticed in the male, and seven only in the female. Similar observations have been made by Scarpa, Guthrie, Langenbeck, and other pathologists. Aneurismal dilatation of the pulmonary artery is extremely rare, and, thus far, I do not remember having met with a well-marked example of it.

We have already stated that aneurism is much more frequent in old than in young persons. In confirmation of the truth of this remark, I may mention that of one hundred and eight cases, collected by Dr. Bizot of Geneva,* from the writings of Morgagni, Corvisart, Laennec, Scarpa, Boyer, Hodgson, Richerand, and S. Cooper, only a single one occurred before the twentieth year. Fifteen were noticed from the age of twenty to twenty-nine; thirty-five from thirty to thirty-nine; thirty-one from forty to forty-nine; fourteen from fifty to fifty-nine; eight from sixty to sixty-nine; two from seventy to seventy-nine; and two from eighty to eighty-nine. Thus it would appear that more persons suffer under this malady from the age of thirty to fifty, than during all the other periods of life put together.

The bad effects of aneurism are ulceration and gangrene, followed by fatal hemorrhage. Occasionally, nature institutes

Fig. 22.



* Recherches sur le Cœur et le Système Arteriel chez l'Homme, dans "Mémoires de la Société d'Observation Médicale de Paris." t. i. p. 400.

a process of reparation, the contents of the tumor becoming coagulated, and the communication between it and the artery shut up.

The *diagnosis* of aneurism of the extremities, neck, groin, or axilla, is usually not difficult. There is a pulsating tumor, either of a globular, ovoidal, or cylindrical figure, which subsides under pressure, but immediately refills with a peculiar whizzing noise as soon as the finger is removed. The progress of the disease is generally rapid, and there is feebleness of pulse, with numbness and œdematosus swelling in the parts beyond the disease. Internal aneurism, on the other hand, is always difficult of detection, especially in the early stage of its developement. When seated at the arch of the aorta, it simulates lesions of the heart, and is not easily identified. The physical signs, upon which our reliance is mainly to be placed, are limited to a preternatural loudness in the pulsations at the upper part of the sternum, often accompanied by a bellows-sound, and dulness on percussion over the same region. In the abdominal portion of the aorta and the common iliacs, the tumor can frequently be recognized by its great bulk, and by its violent beatings. Of aneurism of the pulmonary artery, no diagnostic symptom has yet been pointed out.

Hypertrophy is well exemplified in the arteries of the uterus during gestation, and in the growth of various tumors, especially such as attain a great bulk. In these states of the system, they often become extremely capacious, elongated, and tortuous, being coiled up like varicose veins. The object of this augmentation of volume is to allow a larger quantity of blood to flow into the growing part; and hence, in the instance of the uterus, we find that, as soon as the child is expelled, the dilated and thickened arteries gradually revert to their former dimensions. Hypertrophy of these vessels is generally associated with hypertrophy of the veins, and is, in most cases, purely physiological, there being no discernible lesion whatever of their tunics.

Contraction of the arteries, either alone or associated with dilatation, occasionally exists as a congenital defect; but, in the great majority of instances, it is the result of inflammation, most commonly of the chronic kind, giving rise to fibrinous concretions, tubercular deposits, or calcareous degeneration. In this way, the caliber of the vessel is sometimes completely obliterated, and its texture transformed into a dense ligament-

ous cord, the circulation being carried on by enlarged collateral channels in the same manner as when an artery is secured by ligature. Hitherto, this lesion has been observed more particularly in the larger trunks, especially in the aorta, but no part of the arterial system is exempt from it. Indeed, there would occasionally seem to be a peculiar predisposition to this contraction, the capacity of almost every vessel in the body being sensibly affected by it. The pulmonary artery, although seldom implicated, is sometimes remarkably contracted. In a case observed by Dr. Knox, of Edinburgh, it was reduced to the size of a small goose-quill. Examples of contracted aorta have been reported by numerous pathologists. One of the most extraordinary and instructive cases that has yet been published is narrated by Meckel. It occurred in a Swiss peasant. The aorta, near the arterial duct, was diminished to the volume of a common straw. All the collateral vessels were enormously dilated, and many of them resembled varicose veins.*

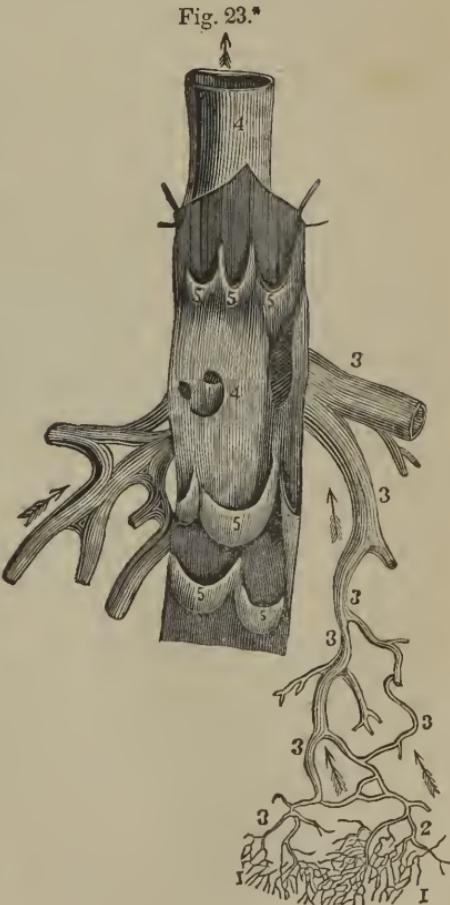
* North American Archives of Medical and Surgical Science, vol. i. p. 155.

CHAPTER VI.

Of the Veins.

More numerous and capacious than the Arteries. — Tunics and Valves; proper Vessels and Nerves. — Lesions. — Acute Inflammation. — Suppuration. — Ulceration. — Chronic Inflammation. — Dilatation. — Obliteration. — Calcareous Deposits. — Phlebolites. — Admission of Air.

THE veins are much more numerous than the arteries, and their united capacity is nearly three times as great. In their general arrangement, structure, and mode of distribution, the closest resemblance exists between the two species of vessels; but it may be observed that the former are more tortuous, that their parietes are thinner, that their anastomoses are more frequent, and, finally, that they are not so regularly cylindrical. (Fig. 23.) Their elasticity, although well marked, is not so great as in the arteries; and their extensibility is likewise less in the longitudinal direction, but more conspicuous in the lateral. In most parts of the body there



* The manner in which the minute branches of a vein unite to form the larger branches and trunks: 1, venous capillaries; 2, small branches formed by union

are two veins to one artery: in some organs, however, as in the stomach, spleen, and testicle, the two species of vessels exist in equal number; and, in a few rare instances, as in the penis, clitoris, and umbilical cord, there is only a single vein to two arteries. The general arrangement of the veins is arborescent, but in a manner the reverse of what obtains in the arterial system; that is to say, they begin in the remote parts of the body by minute rootlets, which increase in size as they diminish in number, forming thus a series of branches, which finally resolve themselves into several large trunks, which terminate in the auricles of the heart,—those of the general system conveying black blood, those of the lungs, blood that has been exposed to the influence of the atmosphere.

Although the tunics of the veins bear a general resemblance to those of the arteries, yet they differ from them in several important particulars, which require brief comment in this place.

The outer tunic is composed of the same substance as that of the arteries, but is much less stong and dense: it is liberally supplied with vessels, and is connected to the surrounding organs by a sheath of loose, cellular texture. The middle coat is also comparatively thin, and is formed of soft, reddish, extensible fibres, disposed for the most part longitudinally. In the large veins, a few appear to run obliquely, transversely, or spirally; but this arrangement cannot always be satisfactorily made out. This lamella is supposed by some anatomists to be of a muscular nature,—an opinion for which, so far as my observation enables me to judge, there is no just foundation. It is, doubtless, merely a modification of the yellow fibro-elastic texture which forms so abundant an ingredient of the corresponding coat of the arteries. The middle tunic is proportionally thicker in the small than in the large veins: it is also more distinctly developed in the superficial vessels than in the deep-seated, and in the veins of the inferior half of the body than in those of the superior. In certain situations, as in the sinuses of the bones and of the dura mater, it is entirely deficient, as is also the external, the serous membrane being alone discoverable.

The internal coat, besides being much more delicate and extensible than the corresponding one in the arterial system,

of capillaries; 3, larger branches uniting to form a great trunk,—4, a portion of which is laid open to show the valves; 5, formed by the inner coat of veins.

is likewise less brittle, and less liable to ossification. It forms, moreover, by its duplications an immense number of valves, the presence of which is of essential importance to the venous circulation. Each fold is of a semi-lunar shape, the convex edge being attached to the circumference of the vessel, whilst the other, which is straight, slightly concave, or reticulated, is loose, and directed towards the heart. The lamellæ of which it is composed are somewhat thicker at the borders than at the middle ; and they are connected together by cellular substance, which is so short and firm as to render it extremely difficult to separate them by means of the knife. In most of the vessels, the valves occur in pairs ; but in some, as in the iliac and femoral veins, they are triple, and in a few even quadruple. In the smaller branches the folds are single ; and a similar arrangement exists at the mouth of several of the larger trunks, such as the coronary vein of the heart and the inferior hollow vein of the trunk.

In regard to the number of valves, much variation exists in different regions of the body. They are remarkably abundant in the superficial veins, less so in the deep-seated, and in the splanchnic cavities there are scarcely any ; they are also more numerous in the inferior than in the superior extremity, and in the subcutaneous vessels of the abdomen than in those of the chest. In certain situations, these structures are absent. There are no valves in the liver, spleen, kidney, uterus, brain or spinal cord ; and they are likewise wanting in the portal vein, the great hollow veins, and in the median vein of the arm. There are but very few in the azygos and pulmonary veins.

Like the arteries, the veins have their appropriate vessels, nerves, and lymphatics : they are surrounded by loose cellular substance ; and, during life, they are always of a bluish tint, owing to the remarkable tenuity of their parietes, which allows the color of the blood to appear through them. After death, they are whitish, semi-transparent, and collapsed.

Acute inflammation of the veins is much more frequent than in the arteries ; the reverse being the case in respect to the chronic form of the disease. It usually implicates a large extent of surface, often affecting a number of veins simultaneously, and, what is remarkable, always tends to spread in the direction of the heart. The anatomical characters of this disorder are swelling, opacity, and pulpiness of the internal membrane, with uniform redness, varying from light

pink to deep florid. The middle and outer coats soon become deeply injected, and their proper substance, although at first preternaturally soft and humid, is at length rendered so dense and firm, that the vein feels like a hard, contracted cord. The cavity of the inflamed vessel is filled with clotted blood, sometimes blended with pus or coagulating lymph, and in many cases it is lined by a false membrane, susceptible, under certain circumstances, of organization. Instances occur in which the pus is infiltrated into the substance of the vein, or collected into small abscesses beneath the lining membrane.

Suppuration is very liable to occur in the veins of the uterus and inferior extremities of lying-in females. This fact seems to have been first noticed in 1793, by Dr. John Clarke, of England. It soon afterwards attracted the attention of Meckel and Reil, of Germany; and, very recently, the subject has been developed in all its bearings, by Dr. Robert Lee and Mr. Arnott, of London, and by Dauice and Tonnelle, of Paris. The pus generally resembles that of a phlegmonous abscess, and sometimes completely fills one or more of the larger veins of the womb and surrounding parts. In a case mentioned by Wilson, the uterine and iliac veins were greatly thickened, and the abdominal cava contained upwards of four ounces of purulent matter, which was prevented from reaching the heart, partly by the contraction of the vessel near its entrance at the diaphragm, and partly by a mass of pseudo-membrane.* Suppuration is also liable to occur after venesection, amputation, compound fractures, and the application of the ligature. In the umbilical vein it often follows the tying of the cord, causing erysipelatous inflammation, which in a few days destroys life.

Ulceration of the veins occurs much less frequently than in the arteries. Commencing most commonly at one or more points of the inner membrane, it gradually extends to the other tunics, which it sometimes completely erodes. The immediate effect of this accident is an effusion of blood, which may be so great as to produce fatal results. The ulcers, which affect various forms, are occasionally quite numerous, occupying a large extent of surface. Dr. Ribes, of Paris, has related a case in which nearly the whole of the

* Transactions of a Society for the Improvement of Medical Knowledge; vol. iii. p. 65.

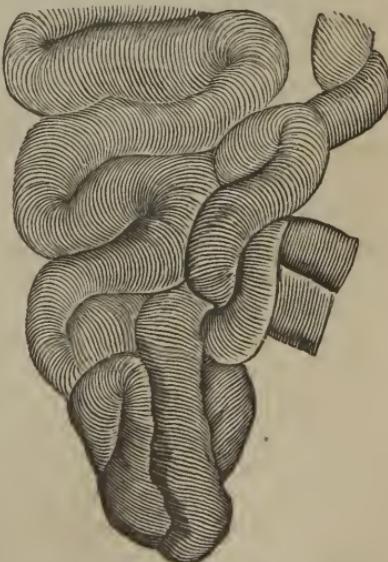
lining membrane of the cephalic, median basilic, and radial veins, was studded with them, the other coats being at the same time much inflamed, thickened, and indurated.

The characters of *chronic inflammation* of the veins differ considerably from the acute. The coats are usually much thickened, hypertrophied, and so dense that the vessel, when cut across, preserves its cylindrical figure, like an artery. The redness is of a brownish tint, interspersed with numerous shades of gray, violet, or purple; and the inner membrane, which is rough and shriveled, can be easily raised in large opaque shreds. In some instances, the vein is dilated, or contracted, obstructed with clotted blood, lined by coagulating lymph, or filled with pus.

There are certain states of the system in which the veins seem to attain a very great size, carrying an inordinate amount of blood. This *hypertrophy*, for so it may be termed, is very conspicuous in chronic affections of the joints, in vascular and malignant tumors, and in the veins of the uterus during the latter months of pregnancy. It is always conjoined with hypertrophy of the arteries, and forms one of the most serious obstacles to the cure of various diseases.

Dilatation (Fig. 24) is most frequently observed in the veins of the testicles and lower extremities, in persons whose employments compel them to stand for a long time in one position. It has also been observed in the superior extremities, and, in a few instances, I have witnessed it in the superficial veins of the abdomen. Of the deep-seated veins, those frequently affected are the subclavian, jugular, azygos, and hemorrhoidal. The vessels, in this disease, become larger, elongated, knotty, irregular, and tortuous, winding in a serpentine manner underneath the skin. Their coats are either of the natural structure, or they are thick and rigid, or thin and expanded, or, finally, they are weak in some places, and hypertrophied in others. When

Fig. 24.



laid open, they are found to be rough and irregularly sacculated, strong bands being sometimes stretched across their interior, which divide the vessel into little cells, filled with coagulated blood. The valves, although they generally retain their normal texture, are sometimes thickened, indurated, displaced, or ruptured. This varicose state of the veins is usually attended by chronic inflammation, and often leads to great and irreparable mischief. In many cases, the vessels are converted into hard, rigid cylinders, or their tunics are invaded by ulceration, followed by perforation and profuse hemorrhage.

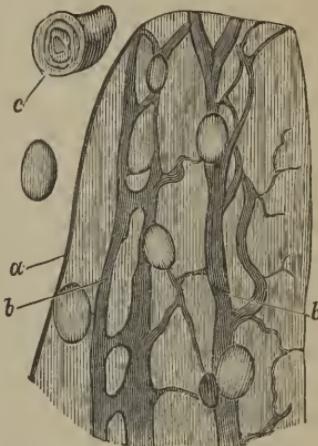
Obliteration of the veins is by no means uncommon, and is almost always the result of inflammation. Sometimes it is caused by the pressure of a tumor, by forcing the sides of the vessel closely in contact, and so converting them into a dense, ligamentous cord. The largest veins are sometimes thus obliterated. Albinus, Baillie, Knape, Ponchelt, and numerous other writers, have related cases where the great hollow veins themselves were either transformed into hard, fibrous cords, or obstructed by coagulating lymph, pus, clotted blood, polypous growths, or morbid deposits. A few years ago, along with Professor Drake and Professor Rives, I examined the body of a man, aged forty, in whom the ascending cava was closed by a plug of plastic lymph, from the second lumbar vertebra as high up as the liver. The vessel retained its normal size, and the morbid substance, which was of a pale straw-color, and of the consistence of semi-concrete albumen, adhered firmly to its inner surface, having evidently been deposited a long time previous to death. A similar substance was found in the portal, and right renal veins, and in several of the smaller veins of the left lung. All the abdominal viscera showed signs of chronic disease, and, during the last two years of his life, the individual suffered at intervals from ascites. In another case, which I saw eighteen months ago, a similar substance was found in the external iliac and femoral veins, together with some of the smaller vessels of the pelvis. The most prominent symptom here, as far as the veins were concerned, was œdema of the corresponding extremity.

Calcareous deposits within the coats of the veins are much more rare than in those of the arteries, this circumstance depending upon their difference of organization. Instances of this, however, are recorded by various authors. Thus Morgagni and Baillie found patches of earthy matter in the walls of the great hollow vein of the abdomen; Beclard in the fem-

oral vein; Macartney and Andral in the external saphenous vein. Whether the venous tissues are liable to the atheromatous degeneration, so common in the arterial, I am not prepared to say; probably they are not: at all events, I am not acquainted with a single instance of it on record, nor have I met with it in my own dissections. A sort of fatty substance is occasionally found. Andral once saw a tumor of this description, about the size of a walnut, which exhibited all the anatomical characters of the adipose texture. It was developed in the substance of the great portal vein, the cavity of which it almost filled.

Loose concretions, *phlebolites*, (Fig. 25,) or *vein-stones*, varying in size from a currant to a pea, are occasionally found in the interior of these tubes. Commonly of a yellowish, brownish, or bluish color, they are of a hard and brittle consistence, and of an oblong, oval, or spherical form, with a smooth, even surface. When divided by the saw, they are found to be made up of several thin but distinct lamellæ, disposed concentrically around a small delicate nucleus, frequently consisting of fibrin. The number of these calculi is extremely variable; rarely are there more than two or three, though occasionally as many as eight or ten, have been observed. In a case examined by Tiedemann, there were thirty-six. They are generally met with in the smaller veins; more frequently, perhaps, in the spermatic, uterine, vaginal, vesical, hemorrhoidal, and splenic, than in any other. According to the analysis of Gmelin, which has been recently confirmed by that of Dr. Prout, vein-stones are composed principally of phosphate and carbonate of lime, with a small amount of animal matter, probably albumen, and a trace of the oxide of iron. A difference of opinion still prevails respecting their mode of origin. Some suppose that they are

Fig. 25.*



* *a*, broad ligament of uterus; *b*, uterine veins containing phlebolites; *c*, phlebolite sawed open, exhibiting its concentric arrangement.

developed in the substance of the veins, from whence they make their way into their interior by destroying the lining membrane; others, on the contrary, believe that they are formed directly from the fibrous matter of the blood itself. The rounded shape and polished surface of these bodies, with the fact that the inner coat is often perfectly sound, strongly corroborate the latter conjecture. Cruveilhier has given a drawing of a number of phlebolites, which appear to have been developed in the very centre of fibrinous concretions; and every pathologist must have seen specimens in which he could clearly trace the progress, so to speak, of these new formations, — some portions being of an earthy nature, and others presenting all the characters of the plastic substance of the blood blended with more or less hematosine.

There is another topic upon which, in concluding this section, it will be necessary to make a few remarks, although it is one rather of a physiological than of a pathological nature. I allude to the fact that air thrown suddenly and in large quantity into the venous system is followed by fatal effects. This circumstance, although long ago known to Wepfer, Chabert, and other writers of the eighteenth century, appears to have been almost entirely forgotten, until it was again brought before the profession by the researches of Bichat, Nysten, Magendie, and Piedagnel. The experiments of these distinguished individuals clearly prove that the insufflation of air into the veins produces instantaneous death, and that, on dissection, traces of this fluid can be detected in different parts of the body, particularly in the right cavities of the heart. As an accidental occurrence, this effect is sometimes witnessed in surgical operations, involving the jugular, subclavian, or axillary veins, and as such it was first noticed by M. Beauchene, of Paris, in 1818, in cutting out a tumor from the neck of a young man. The dissection was nearly finished, when the patient suddenly became faint, and expired in forty-five minutes from the commencement of the operation. On examining the body, an aperture was found in the internal jugular vein, from which the air had evidently passed into the superior cava and to the right chambers of the heart, thereby causing death. Since that period, similar results have been observed by Dupuytren, Mott, Cooper, Warren, and other surgeons.

It is a singular fact, that the effects from this cause are

much less violent, if the air be introduced gradually and in small quantity into the veins. The only difficulty, indeed, that is produced in this case is a momentary excitement of the action of the heart. If the insufflation, however, be repeated for several days, at intervals of six or eight hours, the powers of this organ will become very much weakened, and the pulmonary tissues so far deranged as to give rise to severe cough, frothy expectoration, and considerable embarrassment of the respiratory function. When the air is suddenly injected, the animal is instantly seized with partial syncope, utters cries expressive of suffering, and quickly expires. In the human subject, the accidental introduction of this fluid is sometimes attended with a peculiar hissing noise, like that which is heard when the air rushes into an exhausted receiver. In other cases, symptoms of apoplexy ensue: the countenance is of a livid complexion; the respiration deep and stertorous; the pulse slow, labored, and almost imperceptible; the surface is bathed with cold perspiration, and the patient is perfectly insensible.

The question may be asked, in conclusion,—in what manner does air, when introduced into the venous system, operate so as to produce these deleterious effects? This question, as might be anticipated, has been variously answered by different writers. By some it is maintained that the fluid acts principally, if not entirely, upon the brain, causing symptoms of violent congestion, loss of sensibility, and spasmodic rigidity of the muscles,—an explanation which is favored, in some degree, by the experiments of Nysten and Magendie, in which they induced apoplectic phenomena, by injecting air into the carotid arteries of animals. Others, on the contrary, believe that the primary difficulty is in the lungs, since these organs have been found in a condition similar to what is observed in asphyxia. Piedagnel and Leroy, from having seen these structures in a lacerated and emphysematous state, suppose that death is caused solely by this lesion. But the grounds of these opinions are by no means conclusive; and we are at last compelled to resort to the explanation, long ago suggested by the French physiologists, that the fatal effects in question are the result of the sudden distension of the right cavities of the heart, whereby the powers of that viscus are partially paralysed, and the circulation materially impeded. This view is strongly corroborated, in the first

place, by the fact, already adverted to, that, if the air be introduced into the veins in a slow and gradual manner, little or no functional derangement will manifest itself, in either of the above organs ; secondly, by the almost total failure of the pulse in cases of an opposite description ; thirdly, by the remarkable insensibility of the patient ; and, fourthly, by the circumstance that the foreign fluid is usually found in greatest abundance in the right chambers of the heart.

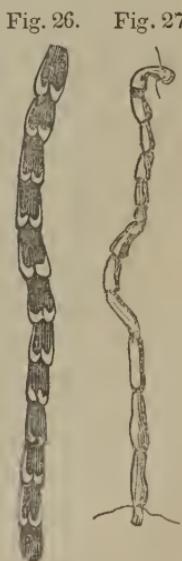
CHAPTER VII.

Of the Lymphatics.

Organization.—Liability to Inflammation and Suppuration.—Tubercular Deposits.—Dilatation.—Aneurism of the Thoracic Duct.—Situation and Structure of the Lymphatic Ganglions.—Lesions.—Inflammation and its ordinary consequences.—Hypertrophy.—Encephaloid Disease.—Tubercle.—Ossification.—Melanosis.

THE lymphatic vessels, closely connected to the surrounding parts by cellular tissue, are composed each of two tunics, an external and an internal. The first, which may be likened to the middle membrane of the arteries and veins, is highly elastic, firm and resisting, of a white-grayish color, and that upon which the tubes depend mainly for their strength and support. Muscular fibres have been supposed to exist in this coat, but this idea is solely conjectural. The internal tunic, which is continuous with that of the veins, but more soft and extensible, is extremely thin, diaphanous, of a serous character, and yields readily in all directions. It presents a large number of short, semi-lunar folds (Figs. 26 and 27,) technically called valves, which give rise to the knotted appearance of these vessels, and which usually occur in pairs, being attached, as in the venous system, by their convex edges. These two membranes are bound together by delicate cellular tissue, and furnished with appropriate arteries and veins. No nerves have yet been detected in them, though we may reasonably infer their presence, inasmuch as both the right and left thoracic ducts, the common centres of the lymphatics, are surrounded each by a venous plexus.

It has been just intimated that all the ab-



sorbents converge towards two principal trunks, called the right and left thoracic ducts. The first of these, situated on the right side of the upper dorsal vertebræ, is formed by the confluence of the lymphatics of the right side of the head, neck, right upper extremity, and some of those of the chest: the other, which is about three lines in diameter, and consequently the largest vessel of this kind in the body, is stretched along the left side of the spinal column, and receives not only the absorbents of the lower extremities, the abdomen, and the chest, but likewise those of the left side of the head, neck, and left upper extremity. Both these trunks, it is well known, open respectively into the right and left subclavian veins, near their junction with the internal jugulars, thus pouring their contents in the current of blood flowing towards the right auricle of the heart.

The lymphatics being so extremely delicate, it is by no means easy to detect in them those various alterations of structure to which they are liable. The following remarks, therefore, embracing a rapid outline of the principal lesions of this system of vessels, will have special reference to the left thoracic duct, in which it is alone possible, in the generality of cases, to detect any deviation from the normal standard.

Bichat long ago affirmed that the lymphatics are much more frequently affected with *inflammation* than the veins,—an opinion which has been amply corroborated by the observations of more recent writers. In the early stage of the disease, the lining membrane is of a light reddish tint, opaque, slightly thickened, and preternaturally dense, yet so friable as to allow itself to be peeled off readily in small pellicles. As in the veins, the discoloration occurs at first in minute, circumscribed patches; but, after some time, it becomes uniform, deeper, and gradually invades the other tunic, the vessels of which, very much injected, may be seen ramifying in every direction, forming a net-work so delicate as to render it difficult to distinguish it with the naked eye. Flakes of lymph are sometimes found adhering to the inner surface; and, in violent cases, it may even be bathed with pus. Under these circumstances, both tunics are of a deep red, violet or purplish color, soft, and spongy, and the surrounding cellular tissue is swollen and infiltrated with serous and other fluids. The proper nutrient vessels, also, being excessively engorged with blood, are no longer permeable to injecting matter.

When the superficial lymphatics are affected, they can be easily traced underneath the skin, like small red cords, tense, nodulated, and painful to the touch, accompanying the principal veins, and going as far as the first conglobate glands, — rarely beyond them. This appearance is well seen in dissecting wounds, in punctures, and in poisonous wounds, and is often attended with considerable swelling and œdema of the connecting cellular texture.

Such is a succinct outline of the anatomical characters of acute inflammation of the lymphatics. Of those which mark the chronic form of the disease, nothing need be said in this place, as the subject does not seem to have yet been properly investigated. That they are very analogous to those characterizing chronic inflammation of the veins, is highly probable ; at least, such must be our conclusion, when we reflect upon the similarity of structure and function of these two systems of vessels.

It has been already stated, that *suppuration* sometimes takes place in these vessels, and it may now be added, that they occasionally contain pus, the result obviously of absorption. Mascagni tells us, that it is by no means uncommon to find purulent matter in the pulmonary lymphatics in phthisical subjects ; and Velpeau and others have repeatedly seen the same thing in those of the womb and inferior extremities in women who died of phlegmasia dolens. It is still undecided, whether acute inflammation ever terminates in gangrene ; but there is reason to believe that such an event is not only extremely rare, but that it never occurs as an idiopathic affection.

Andral has often seen *tubercular* matter in the lymphatics. In a woman who died of cancer of the uterus, in the Charity Hospital at Paris, he found the thoracic duct literally filled with this substance ; and, in another case, besides being present in this reservoir, he noticed it in the absorbents of the lungs, the groin, and pelvis. Similar appearances have been witnessed by others.

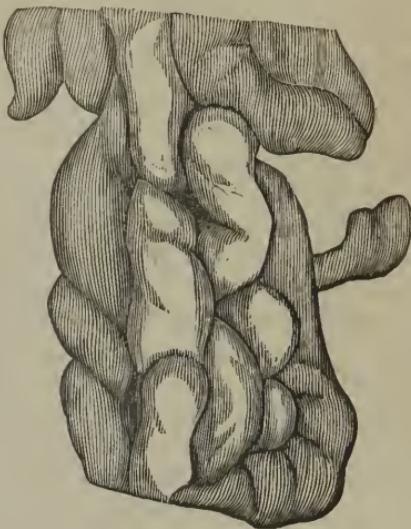
Walther had seen these vessels *ossified*, and of stony hardness ; but this morbid change is much less common than in the arteries, and has only been observed in a few instances. More frequently they contain calcareous, chalky or bony matter ; of this latter, examples are narrated by Scherl, Assalini, Lauth, and Poney.

A remarkable *dilatation* of the lymphatics is sometimes

observed, giving them a tortuous, varicose arrangement. (Fig. 28.) This lesion is well illustrated by a case mentioned by Professor Carswell. The subject of it was a young man, twenty-six years of age, who died with two swellings,—one in each groin, nearly as large as an orange, for which he had worn a double truss from his boyhood, under the supposition that they were of a hernial character. On examining the patient after death, the tumors were found to consist of an enormous dilatation of the lymphatics of the inguinal glands. When cut into, instead of presenting a solid, compact structure, they had the appearance of a coarse sponge,—the size of all these vessels being augmented, most of them from one to three lines in diameter. The same phenomenon was seen, only more strikingly, in the absorbents of the pelvic and lumbar regions. None of them were less than two, and many of them from three to four lines in diameter, whilst the thoracic duct itself was fully three times the natural dimensions. Sœmmerring has seen the lymphatics of the intestines varicose in hernia; and the same condition was witnessed by Bichat, in those of the serous membranes in dropsy.

Dr. Albers, of Bonn, has recently reported a case of what he terms *aneurism* of the thoracic duct. The patient, a man fifty-one years old, died of abscess of the liver. On examining the body after death, a knotty, elastic tumor was found, about the size and shape of a fig, and resembling very much a hydatid. Its walls were preternaturally thick and firm, and, on cutting through them, a director could be easily passed up and down the canal, thus showing that it was connected with the duct in question. The swelling was filled with thin, flaky lymph, and its inner surface was perfectly smooth and uniform. Baillie states that he has seen the thoracic duct varicose, and as large nearly as the subclavian vein.

Fig. 28.



The thoracic duct is sometimes *obliterated*. This may depend either upon a thickening of its tunics, upon the presence of a foreign body, or upon the reciprocal adhesion of its valves, as in the interesting case narrated by Sir Astley Cooper.* In whatever way produced, this occurrence almost always impairs the nutritive function, though, owing to the numerous anastomoses of these vessels, and to their continuation with the veins, this process is perhaps never entirely interrupted, the chyle finding its way along collateral channels, just as the blood does after the tying of an artery.

The other portion of this system consists of small, flattened bodies, of an oval or rounded shape, which have been described by authors under the several names of absorbent glands, lymphatic ganglions, or kernels. (Fig. 29.) Varying in size from two to ten lines, they are of the average diameter of the third of an inch, of a light pink color, and situated always in such places as abound in cellular tissue, particularly at the bends of the joints. At the groin, they occur in great numbers, as well as at the arm-pit, the side of the neck, the posterior mediastinal cavity, and in the cellular tissue of the pelvis and mesentery. In several of these places, they are connected in chains, or clusters.

Each absorbent gland consists of a peculiar parenchymatous substance, surrounded by a thin capsule, made up essentially of condensed cellular tissue, as can be shown by maceration. This envelope, which sends numerous processes into the structure of the gland, is abundantly supplied with blood, the vessels forming upon it a beautiful net-work, which is always deeply injected in persons dying from asphyxia. On making a section of one of these bodies, it is found to consist of a homogeneous, porous substance, soft and fleshy to the touch, the central portion of which is whiter and somewhat firmer than the exterior. This substance is composed mainly of absorbent vessels, remarkably convoluted, dilated into irregular cells, bound together by very delicate cellular tissue, and

Fig. 29.[†]

This envelope

* London Medical Records and Researches, vol. i. p. 28, 1798.

† A lymphatic ganglion, with lymphatics running to and from it.

accompanied by a great number of the finest arterial and venous capillaries.

Thus constituted, these glands are liable to inflammation, suppuration, gangrene, hypertrophy, carcinoma, tubercles, melanosis, and ossification.

In *acute inflammation*, the lymphatic glands are, at first, of a pale flesh-color, hard and dense to the touch, considerably swollen, and cannot be torn with the same facility as in the normal state. When cut into, numerous minute points, of a brownish tint, and evidently the orifices of divided absorbents, may be observed; and, in many instances, blood is extravasated into the connecting cellular tissue, in circumscribed specks, not larger, frequently, than the head of a small pin. The covering of the glands, of a light reddish hue, is every where crowded with injected vessels, radiating in beautiful, dendritic lines. At a more advanced period, these bodies acquire a dark violet color, become soft and spongy, from the infiltration of their bloody matter; and, on being torn, their substance looks very much like that of the spleen.

In this affection, ganglions, that are naturally not larger than the kernel of an almond, sometimes acquire the magnitude of an orange, or even of the fist; as is exemplified in cases of buboes, and in lymphatic swellings in the axilla, or about the neck. The tumefaction arises, apparently, from the internal connecting cellular tissue, or from thickening of the external coat of the absorbents, as these tubes are still pervious to a mercurial injection. This disease may affect a single gland, extend to several, or involve a whole chain or group.

Maceration in water, for a few days in hot weather, deprives the inflamed ganglion completely of its red color, and converts it into a soft, grayish mass, which easily yields to the pressure of the finger. Boiling has the effect, at first, of rendering it dense and slightly elastic,—afterwards, friable and granular.

This disease occasionally terminates by *suppuration*, the period at which this event happens varying from a few days to a fortnight. The pus may be either diffused through the proper parenchymatous structure, converting it into a dirty, grayish mass, or it may be disseminated in distinct globules, or, finally, be collected into an abscess, which may be so large as to occupy the whole gland, the only thing that re-

mains being its external envelope. The quantity of matter is sometimes very great; and, in the majority of cases, it is of a thin, greenish character, intermixed with hard, cheesy flakes. The glands most liable to suppuration are those of the groin, axilla, neck, and jaw.

Acute inflammation sometimes ends in *gangrene*. When this takes place, the substance of the gland is found to be of a dirty, grayish color, soft and pulpy, and bathed in a foul, fetid sanies, occasionally so acrid as to prove highly irritating to the surrounding parts. This termination of acute inflammation is well exemplified in cases of syphilitic buboes, occurring in debauched and worn-out habits. In such patients, immense sloughs are sometimes formed, the gangrene gradually spreading from the affected glands of the groin to the adjacent textures.

In *chronic inflammation*, the lymphatic ganglions are hard, firm, not easily lacerated, and of a light brownish color, interspersed with streaks and specks of gray, which have the effect of giving them a mottled aspect: their substance is infiltrated with lymph; and, on being cut, they slightly creak under the knife, the section presenting a homogeneous aspect. The fibrous envelope is very dense and thick; and both its own vessels and those which are distributed to the proper parenchymatous tissue are tortuous, knotty, and dilated. The absorbents entering into the composition of these bodies are also more or less enlarged, though, occasionally, their cavity is so much diminished as to render it impossible to inject them. The disease sometimes passes into suppuration, the parenchymatous structure being entirely destroyed, the thickened and indurated capsule being the only part that is left. The pus in such cases is semi-concrete, and often remarkably offensive, apparently from its long sojourn in the parts.

Chronic inflammation leaves these glands sometimes in a state of *hypertrophy*. In this condition, they may be either perfectly white or grayish, or else they may acquire a light brownish or yellowish tint; their consistence, also, is frequently much augmented, and cases occasionally occur in which they are of a dense, gristly hardness, like *scirrhus*. The glands most liable to be thus affected are the mesenteric, bronchial, internal iliac, inguinal, and cervical. I have a preparation, taken from a child three years of age, in which the mesenteric ganglions, all melted into one general mass much larger than a foetal head, are of a bluish gray color,

homogeneous, and of the consistence of cartilage, each one grating sensibly under the knife. Many of them are as large as an orange, and they all have a very thick, indurated capsule, of the same tint very much as the altered parenchymatous substance.

Hypertrophy of the lymphatic glands may arise from irritation, seated originally in their own tissue, or it may proceed from irritation propagated to them from the surrounding parts. In the glands of the mesentery, it is commonly caused by irritation of the bowels, especially of the ileum ; in the groin, by that of the penis ; in the axilla, by that of the breast ; in the neck, by exposure to cold ; and at the jaw, by disease of the gums, teeth, or tonsils. Great mischief is sometimes occasioned by this morbid developement. Cruickshank gives an instance in which the bronchial glands were affected to such an extent as to induce fatal suffocation ; and Dr. William Hunter mentions that he has seen the internal iliac glands so much augmented as to cause death by preventing the descent of the child's head during parturition. When those of the mesentery are enlarged they may obstruct nutrition, and produce excessive emaciation, followed at length by loss of life. At the jaw, they sometimes produce permanent ankylosis ; and at the transverse fissure of the liver, an enlarged lymphatic ganglion has been known, more than once, to cause jaundice, by compressing the hepatic or the ductus choledochus. Such are a few of the effects which may result from hypertrophy of these bodies, in whatever manner induced.

We have already mentioned that the lymphatic ganglions sometimes acquire the hardness and density of scirrus, and it may now be added that they occasionally contain *encephaloïd*. This disease, however, is extremely rare, and as yet I have met only with a few instances. When thus affected, these bodies are metamorphosed into a soft, brain-like substance, contained in a strong membranous cyst, with irregular fibrous filaments intersecting it in different directions. Gummy matter is sometimes found in such tumors, and now and then one part is medullary, another fibrous, another scirrhouis. Serous cysts are also occasionally seen. In a case of encephaloïd of the axillary ganglions, which I observed in a man fifty-six years of age, there was a single cavity of this kind which fluctuated under the finger, and contained upwards of eight ounces of scro-sanguinolent fluid.

Cattle are sometimes affected with scirrhus of the absorbent glands, especially such as live in low and damp situations. Cows are more particularly liable to it, and hitherto the disease has been observed chiefly in the glands of the mesentery. Mr. Brown, an English veterinary surgeon, has recorded a singular case, where a body of this kind weighed one hundred and sixty pounds. It was of a very irregular form, and, on making a section of it, it was found to exhibit a bluish, scirrhouss appearance.*

Tubercles are frequently observed in the lymphatic glands, occurring either in small isolated granules, or in considerable clusters. They are generally associated with tubercles of the lungs, and are most common in children between the ages of three and ten. A late writer, Dr. Louis, considers this morbid change as peculiar to phthisis; and he even goes so far as to affirm that it never exists, after the fifteenth year, without pulmonary consumption. This sweeping assertion has been contradicted by M. Broussais. It is certainly at variance with my own, and the experience of our best writers. It is but recently that I examined the body of a man, aged thirty, who died of psoas abscess, in whom, although the lungs were perfectly sound, the lumbar, pelvic, and mesenteric glands were most extensively tuberculized. Nor is this the only instance which I have seen of this disease unconnected with pulmonary phthisis.

This deposition of tubercular matter is much more common in the bronchial glands than in any other. In one hundred children, in which these organs were carefully inspected, Dr. Lombard found them affected in eighty-seven. Age seems to exert a considerable influence in respect to the frequency of this deposition in different parts of the system. In adults, the mesenteric glands are more commonly affected. In one hundred phthisical subjects, Louis found these bodies tuberculized in twenty-three, or in the proportion nearly of one to four. When suffering under this disease, the glands exhibit different appearances, according to the progress it may have made. Generally speaking, they are enlarged in their size, of a dense gristly texture, white externally, and of a light rosy tint internally, either uniformly in streaks or in patches. The tubercular matter itself is of a singularly yellowish color, especially if it has existed for some length of time, and often contains particles of curdy pus.

* Youatt's British Cattle, p. 472.

The lymphatic glands are occasionally *ossified*, and still more frequently, they are transformed into a soft, whitish substance, like chalk. These changes most commonly occur in persons who are cut off by pulmonary phthisis, in the conglobate glands at the root of the lungs; but sometimes they are witnessed in other situations, as in the groin, the mesentery, and pelvis. Not long ago, I met with a case in which a considerable number of the absorbent glands of the neck were ossified. They were perfectly hard, like bone, of a light brownish color, irregularly rounded, and varied in size, from that of a pea to that of a hazelnut. Occasionally the lesion seems to be confined entirely to the cellulo-fibrous envelope of these bodies, their parenchymatous structure either remaining sound, or else containing tubercular or calcareous matter. In the bronchial glands, it is not unusual to find hard sabulous concretions, matted together by cellular tissue; and similar substances, only of a more regular shape, I have several times seen in the lumbar and pelvic glands. In most of the cases which have come under my notice, they were perfectly spherical, smooth, uniformly hard, and very few of them bigger than a currant; they occurred in the midst of the parenchymatous texture, to which they adhered by dense, cellular tissue, and which was, in other respects, entirely natural.

These morbid changes may be considered as resulting from a slow chronic inflammation, similar to that which accompanies ossific deposition in the arteries. Ordinarily, the metamorphosis begins at one or more points, from whence it gradually spreads in different directions, until it embraces the whole gland. When purely ossific, it is supposed by some to be preceded by cartilage, but this, I think, admits of much doubt.

Another morbid deposition which is sometimes noticed in these glands is *melanosis*. Both Andral and Craigie state that this disease is very frequent in Europe, but that it is not so in this country is abundantly proved by the concurrent testimony of our most experienced writers. Excepting in the bronchial glands, this deposition, indeed, is seldom witnessed in any other portion of the absorbent system. Such, at least, is the result of my own observation.

CHAPTER VIII.

Of the Joints.

SECTION I.

Of the Articular Cartilages.

I. *The Articular Cartilages.*—Structure and Chemical Composition.—Vascularity.—Lesions.—Reparation.—Inflammation.—Softening.—Suppuration.—Ulceration.—Ossification.—II. *The Synovial Membranes.*—Organization, Appearance, and Office.—Diseases: Inflammation—Effusion of Lymph and Pus—Ulceration—Chronic Irritation—Loose Cartilages—Chalky Concretions.—III. *The Ligaments.*—Structure and Sensibility.—Adhesive Inflammation.—Atrophy.—Calcareous Concretions.

THE articular extremities of the bones are incrusted with a thin, delicate lamella of cartilage, which adheres to them with so much firmness that it is impossible to separate it without the aid of protracted maceration in warm weather. Of the two surfaces which it presents, one is free, perfectly smooth, and covered throughout by synovial membrane; the other, on the contrary, is rough and mammillated, being studded with numerous little processes, which are received into corresponding osseous pits. In regard to its thickness, the lamella is subject to considerable variation; but it may be stated, as a general observation, that it is greater in the large than in the small joints: it is also greater in the convex articular surfaces at the centre than at the periphery; the reverse of which is the case in the concave. Of a pearly white color, it exhibits, when cut into layers, a semi-transparent, horny appearance, with a light cast of blue. Although seemingly homogeneous, this substance is found to be composed of small, delicate fibres, which are implanted perpendicularly to the surface of the bone, like the villi upon a piece of velvet, only infinitely more close and dense.

During embryotic existence, the articular cartilages exhibit the aspect and consistence of mucilage; but they gradually

augment in density, until at length they acquire the hardness and solidity almost of the osseous tissue. In adult life, they are highly flexible and elastic; in decrepitude, on the contrary, they are dry, brittle, opaque, and sensibly thinner.

These structures are easily cut with the knife. By boiling, they become brittle, indented, and are finally converted into a pulpy, tremulous mass. Exposed to the rays of the sun, or the dry heat of a fire, they assume a transparent, yellowish color; but, by immersing them in water for a few days, they gradually regain their former aspect. They resist, for a long time, the petrefactive process, and months elapse before they yield to maceration. According to the analysis of Dr. John Davy, of Edinburgh, the diarthroïdal cartilages are composed of the following ingredients:

Albumen,	44.5
Water,	55.0
Phosphate of lime, .	.5
	100.0

The results of this experimentalist are somewhat different from those obtained by Allen and Gendrin, who, in addition to the substances already enumerated, detected a small proportion of carbonate of lime, and of gelatine. It is altogether probable that the chemical composition of cartilage, like that of bone, varies very much in the different periods of life. In children, there is generally a preponderance of animal matter, the quantity of which gradually diminishes in old age, being replaced partly by earthy substances.

In the immovable joints, the cartilages are arranged somewhat differently: they form very thin crusts, which are unprovided with synovial membrane, and which, in some of the articulations, are of a fibro-cartilaginous texture.

Are cartilages supplied with vessels and nerves? This is an interesting, and, in reference to the pathology of these textures, a highly important question. That cartilages are as highly endowed with vitality as some of the other parts of the body, is what no anatomist who has investigated the subject will assert; but that they are furnished with all the necessary ingredients of organization, has been abundantly demonstrated by observation and experiment. To deny that they are vascular, as has been done by some, is no less absurd than it is unphilosophical. Does it follow, because the naked eye is incapable of discerning the presence of vessels, that

there must needs exist none? Who has ever demonstrated the vascular structure of the healthy cornea, the arachnoid tunic, or the synovial membranes? No one; and yet that these organs are highly organized, every pathologist must admit, from his own observation. But analogy, in this case, I conceive to be, if not misapplied, at all events unnecessary. Repeated inspection of the cartilages of young animals, as well as of the human subject, has convinced me that these organs are infinitely more vascular than has been generally supposed. The vessels at this period are always large and well developed, carrying red fluid in every direction. In old age, they become less distinct, and many of them, no doubt, are obliterated. In inflammation of the joints, especially in the young, the vascularity of the cartilages, as will presently be shown, is not unfrequently quite conspicuous. In jaundice, I have repeatedly seen them of a light yellowish color, from the deposition of bile. No nerves have hitherto been traced into these bodies; but their existence is indicated, both by analogy, by the presence of vessels, and by the pain which they experience when laboring under disease.

Cartilages, both articular and non-articular, are susceptible of reparation, inflammation, suppuration, softening, ulceration, and ossification.

When divided by a sharp instrument, or torn asunder, as in fractures of the bones, cartilages readily unite, the edges of the wound being at first rounded off, and afterwards joined by a dense fibro-ligamentous substance, whiter and more opaque than the original structure. In some instances, the reparation is effected through the medium of osseous matter; but this is rather a rare occurrence. In this respect, the articular cartilages differ remarkably from the costal, which, when cut or broken, always unite by bony matter, the reparatory process being exactly analogous to that which nature employs in the cicatrization of a fracture. The difference in these two cases depends, no doubt, upon some difference of structure, though it is by no means easy to determine why it is that an organ, which naturally contains less earthy matter than another, should, when injured, be more easily united by bone. The reverse, one would suppose, would be the more natural method. Is cartilage ever regenerated? Laennec and Beclard think it is; and careful observations, made since the time of those celebrated pathologists, fully authorize us in answering this question affirmatively. The reproduction,

however, is generally very imperfect, and serves, therefore, as a very indifferent substitute for the original structure.

Inflammation of the cartilages may occur as a primary affection ; but it more generally succeeds to disease of the osseous, synovial, or ligamentous texture. Its progress is usually slow, and its characters are, for the most part, very slightly marked. In young persons, there is sometimes a considerable degree of redness, the vessels of the joint being enlarged, and continuous with those of the subjacent bone ; but in old subjects this phenomenon is rarely present, the only evidence of the disease being a softened, spongy, and tumid condition of the cartilages. The inflammation is accompanied by severe pain, deep-seated, and of a dull, aching nature ; and in a short time, if its course be not arrested, it is followed by ulceration or destructive mollescence.

Softening of the cartilages seems to be the result commonly of severe inflammatory action, by which their structure is converted into a semi-transparent, pulpy substance, not unlike thick starch. The change, which is sometimes effected with great rapidity, is generally connected with caries of the articular surfaces of the bones, and seems to be somewhat analogous in its character to gangrene of the soft parts.

Genuine *suppuration* of the movable cartilages is seldom if ever met with, the purulent matter which is found in the diarthroïdal joints being generally poured out by the synovial or bony texture. In the pubic and sacro-iliac symphyses, pus has been seen by Ludovici, Hunter, and other writers ; but the occurrence, I presume, is extremely rare. Even in ulceration of this tissue, the formation of purulent fluid is by no means a constant accompaniment.

In gouty affections, the articular cartilages of the fingers and toes are often softened and either partially or entirely removed ; and similar effects are occasionally witnessed in scrofulous disorders of the spinal column, and of the joints of the hip and knee. During the latter stages of utero-gestation, the fibro-cartilaginous substance of the pubic symphysis is sometimes remarkably softened and relaxed, allowing the two contiguous bones to ride upon each other. A case of this kind came under my notice not long since. The lady was in her fifth pregnancy, and the separation which commenced about a month before her lying-in, was so great that she could scarcely walk, or turn in bed without the greatest suffering. The parts were almost as tender as a boil,

and more than five weeks elapsed after her confinement, before they regained their healthy character. This affection, which on the whole is rather uncommon in the human subject, seems to be natural to some of the inferior animals, as the rabbit and Guinea pig,—its object, in them, being evidently to facilitate the parturient efforts. An analogous lesion is sometimes observed in the sacro-iliac junction; but then the softening and concomitant separation are always much less.

Ulceration of the cartilages occasionally exists as a primary lesion; but in most cases it depends upon disease of the adjoining tissues, as caries of the extremities of the bones, or inflammation of the synovial membranes. It may take place at any period of life, or in any articulation; but it is in the hip and knee that it is most generally met with, and in persons between twenty and thirty years of age. In general, the disease is confined to a single joint; but occasionally two or three are affected in the same individual, either simultaneously, or in succession. Its causes are referable to local injury, atmospheric vicissitudes, or to a strumous, gouty, or syphilitic taint of the constitution.

Ulcers of the cartilaginous tissue vary much in their size and form. Sometimes they are small and deep, like excavations; more commonly, however, they are superficial, and occupy a pretty large extent of surface. In the primary variety of the disease, in which the erosion always begins towards the centre of the free surface of the cartilage, the ulcer is sometimes smooth, narrow, and of a light grayish color, as if a portion had been scooped out with a knife; but more generally it is broad, irregular, and of a dull yellowish cast, involving a large amount of structure, and extending into the adjacent bone. The edges are often irregular, never elevated or undermined; there are no vessels to be observed, no granulations, frequently no pus; and the synovial membrane either retains its normal characters, or is vascular, opaque, and slightly thickened. The primary ulcer often spreads with great rapidity, producing complete denudation of the bones in the course of a few weeks. This is especially apt to occur in wounds of the large joints, attended with loss of substance, or the ingress of the atmosphere.

When the ulcers begin in the synovial membrane, or in the articular extremities of the bones, they are called *secondary*, and always possess certain traits by which they may be distinguished from the preceding. These differences, however,

do not consist so much in any thing that relates to the shape, size, or depth of these ulcers, as in the changes which are wrought in the adjoining structures. When the disease depends upon inflammation of the synovial texture, it commonly commences at the circumference of the cartilage, from which it slowly extends towards the centre of the articulation, destroying, as it proceeds, the lining membrane. Should the ulceration, on the other hand, have its origin in the bone, the cartilage will be gradually detached from its connection, partially absorbed, or broken down into a soft, pulpy, gelatinous, or lardaceous mass. This form of the disease is commonly associated with a strumous diathesis, and is most apt to occur in young children in the ilio-femoral articulation.

There is a singular condition of the diarthrodial cartilages, which is considered by Sir Benjamin Brodie as being pretty constantly produced by incipient ulceration. I allude to the peculiar fibrous condition in which the free surface of these bodies is sometimes found. The cartilage seems to be denuded of synovial membrane, and is every where studded with villosities, spicules, or bristles. The affection is most common in old people, and is probably caused by inflammation, attended with slow ulcerative action, or partial absorption.

Ulceration of the cartilages is always accompanied with severe pain, more or less tumefaction, and tenderness on pressure. Every motion of the joint causes uneasiness ; the patient limps in walking, and is unable to exert himself with his accustomed freedom. After some time, the pain becomes more constant and annoying ; there is great constitutional irritation, with loss of appetite and sleep ; and the joint is permanently flexed, or completely disqualified from performing its proper functions. By degrees, matter collects in the articulation, the skin around it ulcerates, and the patient finally falls a victim to hectic fever. Writers have endeavored to lay down certain characters by which this disease might be distinguished when affecting particular joints ; but as an account of them would lead us into unnecessary details, we beg leave to refer such as take a special interest in the subject to the general treatises on surgery.

The cartilages sometimes *ossify*, especially in persons far advanced in life. In the diarthrodial joints, this event is rather uncommon, and is witnessed chiefly in disease of the spine, the hip, and knee. In these situations, the cartilages become not only bony, but are sometimes converted into a substance

similar to ivory. The most frequent seat of ossification is the sacro-iliac junction, which is so often affected in adults that it is regarded by many as a natural occurrence. Several specimens of this kind are preserved in the college museum. In two of these, cartilages of both apophyses are entirely replaced by osseous matter, which has connected the contiguous bones into one common mass.

SECTION II.

Of the Synovial Membrane.

BESIDES the structures already enumerated as entering into the composition of the diarthrodial joints, there is another class which are known, from the fluid which they secrete, under the name of the synovial membranes. These textures, like the serous membranes of the splanchnic cavities, to which they bear the closest resemblance, are every where arranged in the form of shut sacs, which are reflected on the one hand, over the articular cartilages, and, on the other, over the articular ligaments, to both of which they adhere with extreme tenacity.* Their connection with the central portions of the diarthrodial cartilages, indeed, is so firm and obscure, that several able anatomists have been induced to deny altogether their existence in this situation. This opinion, however, is by no means correct, as I am convinced, from a number of experiments that I have performed, with a view of satisfying myself respecting this much-disputed and interesting point. By macerating the cartilages of the hip, knee, or shoulder-joint, for several weeks, or by subjecting them, for a short time, to boiling water, or the action of a dilute acid, I have almost invariably been able to detect these membranes, and to raise portions of them with the forceps. But, independently of their easy demonstrability, the existence of the structures is often rendered evident in certain pathological states of

* In some of the larger articulations, as in that of the hip and knee, loose folds are to be seen, analogous to those of the serous sac of the abdomen. They are formed by the duplicatures of the synovial membranes, and usually contain small masses of fat, which were formerly supposed, but erroneously, to be true secretory glands.

the joints, not only, indeed, merely at the circumference, but at the very centre of their cartilaginous facings.

She synovial membranes have a whitish, semi-transparent aspect, are extremely soft and delicate, and appear to be merely a modification of the cellular element of our organs. Their external surface is closely attached, as we have already seen, to the surrounding textures; the internal, on the contrary, is free, smooth, and constantly lubricated, resembling, in this respect, the free surface of the pleura and peritoneum. No nerves can be traced into their substance; and their vessels, which do not naturally convey red blood, can only be seen when they are in a state of inflammation. Their vital properties are also very obscure.

The free surface of these membranes, as was previously intimated, is constantly bedewed with a yellowish, transparent fluid, of a saline taste, and of a thick, viscid consistence. It is remarkably soft and unctuous to the touch, and is therefore admirably calculated for the office which nature has intended it to perform: heat partially coagulates it, and it readily mixes with water. From the analysis of Dr. John Davy, of Edinburgh, it appears that one hundred parts of synovia consists of

Water,	98'03
Gelatine,	'93
Albumen,	'53
Muriate of soda,	'23
	<hr/> 99'81

In addition to these ingredients, Dr. Davy also detected a small proportion of fixed alkali, and traces of phosphate of lime.

As there are no glands connected with these membranes, it is obvious that the fluid, the physical and physiological properties of which we have just described, must be immediately derived from the vessels which are distributed through their substance. Its quantity varies in the different joints; for, whilst in some it can scarcely be said to exist in an appreciable manner, in others, as in the hip and knee, there is always, comparatively speaking, quite an abundance of it.

Synovial membrane readily unites when torn or divided, and is highly susceptible of inflammation.

All the joints are liable to inflammation of their lining membrane, but that of the knee is perhaps more frequently affected than some of the others. The disease is most apt to

occur when the body has attained its full vigor, and may be produced by a great variety of causes, such as external violence, cold, the long-continued use of mercury, gout, rheumatism, or syphilis. The anatomical characters of the acute variety of the malady are, redness, opacity, thickening, and diminished density of the affected membrane, with alteration of secretion, and infiltration of the surrounding cellular substance.

In the early stage of the disease, the redness is commonly very slight, the capillaries being disposed in delicate lines, separated by large intervals. After some time, however, the vessels assume an arborescent form, and the color becomes more intense, occurring either in a uniform manner, or in minute patches, resembling so many ecchymoses. As these changes proceed, the membrane loses its smoothness and transparency, augments slightly in thickness, and becomes so soft that it may be easily scraped off with the finger-nail, or the edge of the scalpel. The natural secretion, which is at first increased in quantity, thin and limpid, is soon rendered thick and turbid, and often contains flakes of lymph. At a more advanced degree, the secretion is entirely changed in its character, being puriform, sero-sanguinolent, or even purulent. Occasionally clots of pure blood are contained in the joint; and, in many instances, the free surface of the membrane is covered with minute shreds and globules of lymph, which have the effect of giving it a rough, tomentous aspect. The surrounding cellular tissue is distended with serum, and the vessels penetrating it are engorged with blood, which is so firmly impacted into them that it cannot be easily forced out.

The quantity of lymph thrown out in this disease is sometimes very great, filling up nearly the whole of the affected joint. It is generally of a pale straw-color, grayish, or lilac, and often adheres very intimately to the inner surface of the articulation, being spread out in the form of an adventitious membrane. I do not know that vessels have ever been traced into this substance, but that it is susceptible of organization there can be no doubt.

Suppuration of the synovial membranes is very apt to take place in serofulous persons, and in such the matter is generally of a thick, flaky character, like that of a psoas abscess. In most cases, the pus is remarkably viscid and ropy, owing to the admixture of synovial fluid, and not unfrequently it is of a dark grumous appearance, and more or less offensive.

When the accumulation is small, it is sometimes absorbed, but more commonly it works its way out through the joint by the ulcerative process, and destroys the patient by constitutional irritation.

The synovial membranes are liable to ulceration. This occurs especially where they are reflected over the peripheral portions of the joints. The edges of the erosions are generally very thin, and their size seldom exceeds that of a ten cent piece. It is difficult to say, in these cases, whether this ulceration begins in the membrane itself, in the subjacent cellular tissue, or in the substance of the cartilage. But, be this as it may, the latter of these textures are always sooner or later involved in the process, and in this way small superficial abrasions are often converted into deep cavities.

In the *chronic* form of the disease, in which the vascularity is much less than in the acute, the membrane often presents a remarkably dull, mottled appearance. Its substance is sometimes very much thickened, either by an effusion of sero-albuminous matter into its molecular texture, or by the formation of adventitious membranes; and not infrequently, especially in cases of long standing, it is converted into a soft pulpy mass, of a light brownish color, intersected by numerous whitish shreds. Cases occur, in which the synovial membrane is covered with multitudes of small pendulous excrescences, something like melon-seeds, warts, or the epiploic appendages of the large intestine. Occasionally, fibro-cartilaginous tumors grow beneath it, of considerable magnitude, adhering by one or more foot-stalks. These productions are usually very irregular in their shape; and as they are generally invested by a duplicate of the synovial membrane, it is not unreasonable to infer that they are originally developed in the subjacent cellular tissue.

Loose cartilages are sometimes found in the joints, especially in the knee, where they are often a source of great trouble and anxiety to the patient. They vary in size, from a mustard seed to that of a small bean; occasionally, however, they are much larger; and, in one instance, a body of this kind was found of the magnitude nearly of the patella. Their numbers also vary. In most cases, there are not more than three or four; but Haller saw a case in which there were twenty; and Morgagni another, in which there were twenty-five. These concretions are generally concave on one side, convex on the other, and of an irregularly oval

form. Sometimes they are lenticular, rough in one part, and smooth in another, or are marked round their circumference by a red striated zone. Consisting ordinarily of a single mass, they are occasionally divided into several lobules, which are connected together by fibrous matter. In some instances, they are tough and tenacious, or soft, like ligamentous texture; but, mostly, they are partly cartilaginous, and partly osseous, the bony structure being in the centre, the cartilaginous on the surface. These substances, like the fibro-cartilaginous tumors before mentioned, are probably developed in the subserous cellular tissue: they are covered by synovial membrane, and they finally become detached through the accidental rupture of the slender pellicle which joined them to the part on which they grew.

The diarthrodial joints are occasionally the seat of gouty concretions, which, from their color and softness, have received the name of *chalk-stones*. The true nature of these bodies was first discovered by Dr. Wollaston, in 1797, who proved that they are composed of urate of soda. More recently, John Davy has detected, besides this substance, a peculiar fatty matter, phosphate and carbonate of lime, and a minute quantity of carbonate of magnesia. In an old man, whom I examined some years ago, I found these concretions in nearly all the principal joints of the body, in small amorphous masses, of a whitish color, and of a soft unctuous consistence. Sometimes they are perfectly smooth and round; more commonly, however, they are rough and irregular, grooved or nodulated. In most cases they are small, though they have been observed of the size of an egg. These bodies are almost always connected with a gouty diathesis, and are, no doubt, caused by chronic inflammation of the synovial texture.

In chronic inflammation, the fluid which is thrown out is either thin and glairy, sero-oleaginous, or puriform, — rarely purulent. The quantity varies from one to five ounces, and in some rare cases it has been known to amount to more than a quart. This affection, which is distinguished by the term “dropsy,” is rarely attended with much pain or inconvenience.

SECTION III.

Of the Ligaments.

Two varieties of ligaments enter into the composition of the movable joints, the capsular and funicular; the former of which seem to partake a good deal of the character of the fibrous membranes, while the latter are always extremely dense, firm, resisting, and of a dull white argentine color. They possess only a very slender share of elasticity, and yield scarcely any when an effort is made to stretch them. Their supply of blood, which is furnished by the small arteries in their immediate vicinity, is extremely scanty; and, as yet, few anatomists have succeeded in tracing any nerves into them. By protracted maceration, these structures may be reduced into a soft, pultaceous, grayish mass, which can be almost entirely resolved into gelatine by boiling.

The sensibility of the ligaments is extremely obscure in the normal state, so that they may be cut with a pair of scissors without the individual being conscious of it. In this respect, they resemble the other fibrous tissues; but differ from them in the excruciating pain which ensues when they are forcibly stretched or contorted. Their sensibility is also remarkably heightened under inflammatory irritation. They are entirely destitute of contractility of texture; and, when injured, they are seldom if ever repaired.

The diseases of the ligaments are few in number and infrequent in their occurrence, owing, no doubt, to their very imperfect vascular and nervous endowments. The most important morbid changes are inflammation, atrophy, gouty concretions, and lardaceous degeneration.

When a ligament is cut or lacerated, it readily unites by *adhesive inflammation*, the process being exactly analogous to that which occurs in the restoration of a fractured bone. The vessels of the part, becoming enlarged, throw out lymph, which forms a capsule round the divided extremities, and thus keeps them in contact. The same kind of matter is afterwards effused between the ends of the ligament; and, in proportion as this becomes organized, and assumes the properties of the original texture, the outer capsule, to which we have just referred, is diminished, until at length it is wholly absorbed, leaving behind it merely a slight cicatrix.

Doubts have been expressed by some writers whether ligaments are susceptible of *inflammation*. That they are occasionally the primary seat of this disease, cannot be denied ; and that they become often affected secondarily, is equally certain. The dissections of Sir Benjamin Brodie and other distinguished writers have fully established the latter point ; and, as respects the former, its existence is daily witnessed in gouty and syphilitic disorders of the joints. When laboring under inflammation, the ligaments generally give rise to the most severe suffering, aggravated during the night, and leading to great constitutional irritation. This is well exemplified in sprains, which are always among the most painful accidents. The physical properties of these textures do not seem to be much altered in the early stages of the inflammation : they retain their white argentine aspect, and here and there may be discovered a straggling capillary. Subsequently, they become more vascular, and their substance is infiltrated with serous, albuminous, or sero-sanguinolent fluid. If the disease continues its ravages, the ligament breaks down into a soft, lardaceous mass, containing white, silvery shreds, but no trace of vessels. No pus is secreted during these changes ; indeed, it is doubtful whether this fluid is ever deposited by this species of tissue, however much it may be inflamed.

Atrophy of the ligaments is sometimes produced by the pressure of an aneurismal tumor, or other morbid growth ; but it more commonly arises through disease of the surrounding textures. When the muscles of the shoulder or hip are paralysed, the capsular ligaments of those joints are not infrequently so much attenuated and relaxed as to allow the bones to slip out of their sockets, and this occasionally in a very short period. Similar phenomena are sometimes witnessed in the temporo-maxillary articulation, and in the joints of the fingers and thumb. In these situations, indeed, spontaneous dislocations, from atrophy of the ligaments, are by no means uncommon.

Calcareous concretions, of the same character as those which are deposited within the synovial sacs, are sometimes found in the ligaments. When this matter is very abundant, as it is apt to be in persons of a gouty diathesis, it has a tendency to fret and irritate the ligaments, and to render them highly sensitive, and liable to hypertrophy.

CHAPTER IX.

Of the Osseous System.

SECTION I.

Of the Bones.

- I. *The Bones.* — Notions of the older Writers respecting their Organization. — Vessels and Nerves. — Chemical Constitution. — Effects of Heat and Acids. — Classification. — Compact, Areolar, and Canalculated Textures. — Diseases of the Bones. — Reparation. — Inflammation. — Suppuration. — Ulceration. — Gangrene. — Softening. — Fragility. — Hypertrophy. — Atrophy. — Hydatids. — Aneurism. — Carcinoma. — Melanosis. — Tubercl. — II. *The Periosteum.* — Its fibrous structure liable to the same kinds of Diseases as the fibrous Membranes generally. — Hypertrophy. — Ossification. — Is seldom, if ever, affected by the Heterologous Formations. — III. *The Medullary Membrane.* — Situation and Character. — Diseases few, but important.

THE notions of the older anatomists respecting the organization of the bones, were exceedingly vague and unphilosophical. Many classed them among what they called the bloodless structures; and not a few imagined that they were entirely destitute of vitality. More correct observation, however, whilst it has long since exposed the fallacy of this opinion, has fully demonstrated that the bones, like the other organs of the body, possess a great abundance of vessels, so that they grow, waste, and are repaired; and that their diseases differ in no respect, save in the tardiness of their progress, from those of the soft parts. Nerves and absorbents do exist in the osseous tissue, probably in vast numbers, though it is difficult, if not impossible, to demonstrate them by the usual processes.

The bones owe their importance in the economy to their mechanical properties: they are entirely passive in their character, forming so many solid pieces for the action of the muscles and their tendons; and hence, although they are furnished with vessels and nerves, they are destitute of that

sensibility which forms so striking an attribute of the soft parts. It is owing to this circumstance, that, in the normal state, the osseous tissue may be sawed, rasped, cut, or even cauterized, without the slightest indication of pain. When this substance is laboring under disease, it always becomes highly sensitive, and often gives rise to the most excruciating suffering. Nothing, therefore, can afford a better proof of the vitality of the bones than this fact; for, although this property, as just mentioned, is quite obscure in their sound state, yet, when morbidly affected, they are subject not only to inflammation, but likewise to suppuration, ulceration, and even gangrene, — thus showing, in the most conclusive manner, that they possess the same organization, only in a less degree, as the other parts of the body, of which they have too frequently been considered, if I may so express myself, as semi-dead appendages.

The vessels of the bones, which enter their surfaces at every point, may be demonstrated by injection, and a variety of other means, as sawing, cutting, and rasping. When they are filled with fine red matter, and steeped in dilute muriatic acid until the earthy matter is removed, they will become quite distinct, especially if the part so treated be afterwards immersed in oil of turpentine. The vessels of the bones undergo remarkable changes in consequence of age. In infancy and youth, they are not only comparatively larger, but they are also much more numerous than in the old and the decrepid. These differences give rise to differences of color. In the young subject, the bones are of a bluish tint; in the adult, on the contrary, they are pale and almost white. In death from drowning, they are naturally well injected and highly vascular; and, in dropsical persons, they are generally remarkably blanched.

I have never succeeded in tracing any nerves into the bones, nor have others been more fortunate. Some of the French anatomists, it is true, pretend that they have occasionally followed branches of the fifth pair through the nutrient foramina; but their dissections have not, I believe, been verified by subsequent investigations. As to myself, I have long been of the opinion that the nerves of the osseous tissue are conveyed to it through the medium of the arteries; that they enter the same apertures, and that they are so completely concealed in their coats as to baffle all attempts at discovery. Whether this view is correct, future observation

can alone determine: it is certainly plausible, and strongly supported by analogy.

Although the osseous tissue has been submitted to analysis by a great number of distinguished chemists, yet the results which have been obtained are by no means so satisfactory as could be desired. According to Berzelius, one hundred parts of human bone consists of nearly thirty-three of gelatine, fifty-one of phosphate of lime, two of fluate of lime, and eleven of carbonate of lime, together with a small quantity of phosphate of magnesia, soda, and chloride of sodium. Fourcroy and Vauquelin met with no fluate of lime in their examinations, but detected some oxide of iron and manganese, silex, alumine, and phosphate of ammonia. The chemical composition of the osseous tissues varies considerably in the different stages of life under different circumstances of health and disease, in different pieces of the skeleton, and even in different parts of the same bone. In infancy and childhood, the relative proportion of animal matter is at its maximum, the earthy at its minimum. In advanced age, from the great predominance of phosphate and carbonate of lime, the osseous tissue is remarkably brittle, and prone to fracture.

If a portion of bone (Fig. 30) be subjected to a charcoal fire, and the heat be gradually raised, it will be found to burn first with a considerable flame and to emit a disagreeable animal odor, and at length to become almost perfectly red. If it be now carefully removed, and permitted to cool in a slow and gradual manner, it will exhibit a white chalk-like appearance, and be so light and brittle as to crumble on the slightest touch. In this operation, the animal substance is extracted by destructive decomposition, whilst the earthy matter remains almost entirely unchanged; at the same time that the bone retains its mechanical figure, having merely lost a small portion of its weight. These results may also be obtained in a more or less perfect manner by long-continued boiling. A large part of the animal substance will thus be extracted,

Fig. 30.



and furnish a solution, which, on cooling, gradually concretes into a tremulous jelly-like mass.

If, on the other hand, a bone be exposed for some days to the action of a solution of nitric, muriatic or sulphuric acid, the saline ingredients will be gradually withdrawn, whilst the organic part remains and becomes gradually soft, flexible, and elastic, (Fig. 31.) When dried, it will be found to have lost a portion of its weight, which is in direct proportion to the quantity of earthy matter taken up by the acid ; yet it will be impossible to perceive that the least atom of its substance has been mechanically removed, or that its form and aspect have been in any wise altered.

In regard to their varieties of form, the bones may be divided into four classes, — the long, the broad, the short, and the mixed. The first, which are situated in the extremities, form a series of broken columns, which increase in number, but diminish in size, as they recede from the trunk. Each piece consists of a body, which is cylindrical in some, triangular in others, and in nearly all a little curved, and of two heads, which are thick and expanded. But what particularly distinguishes the long bones is the fact of their having an internal canal, which is usually of the same configuration with their shafts, and which is occupied, in the recent state, by the marrow and medullary membrane.

The broad bones assist in enclosing the cranial and pelvic cavities : they are, for the most part, exceedingly irregular in their form ; and of the two surfaces which they present, one is generally convex, the other concave.

The short bones are arranged in groups, forming masses which combine mobility with solidity : they are characterized by an equality of length, breadth, and thickness, by which they may be readily distinguished from the other pieces of the skeleton.

Fig. 31.*



* Animal substance of the radius, the earthy part being removed by the action of acid, leaving the remainder perfectly flexible.

In the fourth division are included those parts of the skeleton which combine the form and character of the other classes. They are situated chiefly in the cranium and the chest, and consist of the occipital and temporal bones, the sphenoid and ethernoïd, the ribs, the clavicle, and the sternum. The form of these pieces is too irregular to admit of any general description.

Although these different classes of bones all consist essentially of the same anatomical and chemical constituents, yet their texture is varied, not only in each division, but in different parts, frequently, of the same piece. The principal modifications of form of the osseous tissue are three,—the compact, the areolar, and the canaliculated, (Fig. 32.) The compact substance occurs, in a greater or less degree, in every bone in the skeleton; but it is in the long that it is more particularly conspicuous, especially in their bodies, where it forms a layer of great thickness, which gradually diminishes as it approaches the extremities. In its texture, this substance is so remarkably close as to render it impossible to detect any interstices in it with the naked eye. With the aid, however, of the microscope, we are enabled to discover numerous minute canals, which freely communicate with the canaliculated and spongy structures, which are designed for the transmission of the capillary vessels of the periosteum. These apertures, the existence of which was first clearly demonstrated by the celebrated Havers, an English anatomist, are found in great abundance throughout the whole skeleton, and their diameter varies, according to the recent measurements of Dr. Miescher, from the three to the eight hundredth part of an inch. In the long bones, the canals are directed obliquely; in the broad, on the contrary, they run parallel with the external surface. In many places, they pursue a transverse course.

Fig. 32.*



* A section of the femur, showing its structure and medullary cavity.

When carefully examined, the compact texture appears to be made up of numerous concentric lamellæ, which are bound together by horizontal and oblique processes, and the thickness of which varies in different parts of the skeleton, from the fiftieth to the five hundredth part of an inch. This arrangement, which is best seen with the microscope, can be satisfactorily displayed by exposing a bone for a long time to the weather, and by protracted maceration in water after it has been deprived of its earthy salts. It is also rendered perceptible occasionally, on a rough scale, in mortification of the osseous tissue.

The *areolar texture* is not so extensively disseminated as the compact; nevertheless, it occurs in nearly every part of the skeleton. It is particularly abundant and well marked in the short bones and in the extremities of the long, and evidently results from an interlacement of osseous filaments, prolonged inwards from the canaliculated structure. The cells, which are thus formed, vary extremely in regard to their size and shape in different parts of the bony system; but they all freely communicate with each other, as may be proved by pouring quicksilver into them. This spongy substance, whilst it contributes materially to the lightness of the skeleton, subserves the more important purpose of a reservoir for the medullary membrane, and a surface of distribution for the blood-vessels.

The *canalicular texture*, which is interposed between the compact and areolar, occurs in all the parts of the skeleton, but is least evident in the broad bones. It consists of an assemblage of small, tortuous tubes, of an irregularly cylindrical shape, nearly parallel with each other, and the sides of which are pierced with minute apertures. In the long bones, they pursue a longitudinal direction; but, in the short, they run from one articular surface to the other. Many of these canals communicate together, and their office, like that of the canals of Havers, by which they are chiefly formed, is to afford passage to the blood-vessels, as they proceed from the compact to the less dense substance of the osseous system.

Bones, deprived of their earthy matter, exhibit a homogeneous appearance; but by prolonged maceration in water they may be resolved, as before stated, into different layers, each of which will be found, upon examination, to consist of a series of filaments, disposed in a longitudinal, oblique, or horizontal manner. By continuing this process, the filaments

here referred to, will gradually become soft and swollen, and at length present an areolar texture, similar to the subcutaneous cellular substance. It may reasonably be concluded, therefore, that this areolar texture is the nidus which receives the hard, calcareous, inorganic matter which imparts to the osseous tissue its firmness and characteristic properties.

Having premised this brief sketch concerning the organization of the osseous tissue, which seemed necessary to a more perfect comprehension of its diseases, let us proceed, in the next place, to consider its various lesions. Of these the most important are the following : inflammation, suppuration, ulceration, gangrene, softening, fragility, hypertrophy, atrophy, hydatids, aneurism, carcinoma, melanosis, and tubercle.

The *restoration* of a fractured bone is effected by adhesive inflammation, analogous, in many respects, to that of the soft parts. The changes which attend it, and which are among the most interesting in the whole range of pathological inquiry, may be referred to four stages, each of which will require separate notice. In the first stage, which extends over a period of about five days, the efforts of nature are altogether of a preparatory character, being limited to the absorption of the blood, which was poured out at the moment of the accident. At the expiration of this time, a change supervenes, which bears a close resemblance to inflammation ; that is, the soft structures around the fracture become hot and vascular, their vessels enlarged and deeply injected, and their cells infiltrated with thick, viscid lymph. The same substance is effused between and around the broken ends, as well as within the medullary canal, and in this manner all the injured parts are temporarily glued together. This substance, which is of a light pink color, and of a soft, gelatinous consistence, is what is named *callus*, the real nature of which was a source of so many disputes amongst the ancient pathologists. As the restorative process advances, bony matter is gradually deposited upon the surface of the medullary membrane, until at length a dense, solid plug is formed, which fills up the internal canal, and holds the fragments in contact. Whilst these changes are going on in the interior, the matter which has been effused upon the surface of the broken pieces also experiences important alterations. At first, as was before intimated, it is perfectly soft and gelatinous ; but by degrees it becomes firm and elastic, like cartilage, and finally assumes all the properties of real bone. This substance is termed the *provisional callus*. It completely encases

the fragments, adhering firmly to their outer surface. The quantity of callus is always in direct proportion to the amount of injury; and hence it is usually greater in an oblique or comminuted fracture than in one that is transverse.

In the third stage, the broken bone itself becomes sensibly changed; the lymph which was effused between the fragments, and which until now experienced little alteration, acquires consistence and firmness; numerous vessels are developed in it which communicate with those of the surrounding structures; and at length, ossification being completed, the two ends of the broken bone are firmly reunited. The period required to effect these changes, is greatly influenced by the age and constitution of the patient, the plan of treatment, and the nature and seat of the fracture; but, in general, from six to eight weeks may be said to elapse between their commencement and completion.

In the fourth and last stage, embracing a period of several months, the provisional callus is gradually absorbed, the soft parts resume their natural state, the prominence formed by the new bone diminishes, and the internal osseous plug is wrought into cells and cavities, by which the medullary canal is at last completely re-established.

Thus it appears, as has been already hinted, that the process by which a broken bone is reunited is truly analogous to that which nature adopts in restoring wounds of the soft parts. The only difference seems to consist in the changes which occur in the surrounding parts, and in the formation of the provisional callus. But, in order to render this process effectual, it is necessary that the broken bone should be kept at rest, that it should be provided with a due amount of animal matter, and that the vascular connection between it and the adjacent structures should not be too much interrupted. If these conditions be absent, the restoration will be imperfect, or a false joint will be formed. Fractures of the neck of the thigh bone, the patella, and olecranon, rarely unite by osseous matter, but in almost all cases through the medium of a white, fibro-ligamentous substance. The causes of this imperfect reproduction are not very obvious; though it is not improbable, I think, that they consist chiefly in a defect of periosteum, in inefficient nutrition, and in the difficulty which the surgeon experiences in maintaining the fragments in proper apposition. That the union of internal parts greatly depends upon the changes which take place in

the surrounding textures, is a fact which has been abundantly verified by observation; and that false joints are often produced by bad and injudicious management is equally true. In the examples, then, before us, it may be supposed that these are the principal if not the sole agents, which interfere with the restorative process. In the case of the neck of the thigh-bone, the influence of the periosteum, in the production of osseous matter, is strikingly illustrated by the fact, that, if the fracture be seated partly without and partly within the capsular ligament, the former will unite by bone, the latter by fibrous matter.

When a *false joint* is thus formed, the ends of the broken bone are gradually rounded off, and converted into a smooth, secreting surface, which discharges a thin, oily fluid, not unlike synovia. The surrounding cellular substance is at the same time condensed; and in this manner it is made at length to answer the purposes of a capsular ligament.

Osteitis was formerly supposed to be of very rare occurrence; there is reason to believe, however, that it is not only a frequent malady, but that it is present, in some form or other, in almost every affection of the osseous tissue, whether primary or secondary. The bones most commonly affected are those of the extremities, especially the tibia, which, from its exposed situation and consequent liability to injury, seems to be particularly prone to it. The inflammation may be primarily seated in the osseous structure, or it may be propagated to it from the soft parts: in either case, the periosteum and medullary membrane are apt, sooner or later, to become implicated in the disorder. The malady is generally slow in its progress, and hence it often happens that a considerable period elapses before there are any appreciable alterations of tissue. At first, the bone is simply enlarged; but, in a short time, it loses its density, becomes infiltrated with sero-sanguinolent fluid, and assumes a bright reddish hue, the capillaries being very numerous, turgid, and distinct. As the disease advances, the osseous fibres separate from each other, and the widened intervals are filled with a soft gelatinous substance, mixed with which it is not unusual to find small clots of blood. These changes are generally attended by an absorption of earthy matter, which has the effect of rendering the bone soft and spongy, at the same time that it causes an actual diminution of weight. This, however, is not an invariable phenomenon,—cases occasionally occurring .

where the phosphate and carbonate of lime are deposited in inordinate quantity, by which the osseous tissue is made preternaturally brittle. When the inflammation is superficial, it usually extends, as was before remarked, to the periosteum, which becomes hot, red, and swollen, — in a word, manifests all the signs of ordinary inflammation. When the medullary membrane is implicated, it becomes bloodshot, and the adipous matter is either rapidly absorbed, or it is transformed into a soft diffused mass, of a light reddish color, and of a peculiarly offensive odor. When the ossific inflammation is fully established, the engorged capillary vessels refuse to receive injecting matter, and can be drained of fluid only after protracted maceration. The pain attending this disease, is commonly of a dull aching character, and is apt to be worse at night than in the day-time. When the periosteum is involved, it is more severe, — sometimes, indeed, almost intolerable.

Osteitis sometimes terminates in resolution, but more frequently, perhaps, in suppuration, ulceration, or gangrene. *Suppuration* of the external substance of the bones is a very common occurrence ; but, as it is ordinarily complicated with periostitis, it is difficult to determine which structure is the source of the purulent secretion. It is most frequently observed in connection with some constitutional taint, such as scrofula, syphilis, or the protracted use of mercury ; but it may, and very often does, exist as a purely idiopathic disease. When suppuration takes place in the spongy texture of the bones, the pus is sometimes contained in a delicate, vascular cyst, composed of coagulating lymph. Several such collections are occasionally found in a single bone. In a carious tibia which I inspected several years ago, there were three distinct abscesses in the upper extremity, the largest of which did not exceed a common almond, whilst the smallest was scarcely of the size of a pea. They were lined each by a soft, vascular membrane, and the bony texture in the neighborhood was unnaturally hard and white. The subject was a female, forty-five years old, who finally died of pulmonary phthisis. Abscesses of this kind, it should be observed, seldom attain any considerable magnitude : their formation is attended with severe pain, and their contents are dark-colored, thin, and offensive ; and, if seated near the extremity of the bone, the matter usually manifests a tendency to work its way into the contiguous joint.

Ulceration of the osseous tissue is most generally met with in young persons, being rarely observed in the adult or very aged. The disease, which is usually known in the books under the name of *caries*, is precisely analogous to ulceration of the soft parts, the most prominent feature of each being a loss of substance through absorption. It is always preceded, as well as accompanied, by inflammatory action, and may be owing either to local injury or to constitutional causes, such as syphilis, scurvy, scrofula, or deficient nutrition. It may also result from the pressure of aneurismal tumors, or from the spread of malignant ulcers in the soft parts.

Every part of the osseous system is liable to caries; but the pieces most frequently attacked are those which form the walls of the thorax and pelvis. The bones of the tarsus and carpus, the bones of the spine, and the heads of the cylindrical bones of the extremities, especially the lower.

Various attempts have been made to arrange caries into different species, the distinction being usually founded upon the appearances of the affected bone, and upon the nature of the exciting causes of the disease. Mr. Mayo, one of the most recent writers on the subject, states that there are four kinds of caries,—the simple, syphilitic, strumous, and malignant. The older writers had a still greater number, and every one, indeed, seems to have as many divisions as suits his particular fancy. Without wishing to substitute any classification of my own, I believe that, for all practical purposes, it will be sufficient to divide the disease into two species,—the superficial, and deep-seated; the one commencing in the compact, the other in the spongy structure of the osseous texture.

Caries often goes on for a considerable period without there being any ulceration of the soft parts; and, in such cases, the diagnosis is usually extremely difficult. In the majority of instances, however, the nature of the complaint is indicated by the dull, aching pain, the tenderness on pressure, and the red, inflammatory state of the skin. After some time, the superincumbent parts become loose and boggy, and at length one or more apertures appear in them, through which there is discharged a very fetid, dark-colored, or grayish sanies. The bone which is thus exposed, has a foul and corroded aspect, its texture being softened, and infiltrated with a thin brownish fluid, mixed with blood, or with a yellowish, ropy substance, not unlike ill-elaborated pus. The ulcers some-

times occupy quite a considerable extent of surface ; but, in most cases, they are small, and of a rounded or oval shape. Their edges are steep, elevated, or abrupt, and their bottom is generally studded with small, osseous points, which have the effect of making it rough and irregular. The erosions have sometimes a very great depth, and in the broad bones it is not uncommon to see them involve both tables, giving them thus a singularly cribriform appearance. Occasionally they have a sinuous arrangement, the affected surface bearing a close resemblance to the bark of a worm-eaten tree. The osseous texture in the immediate neighborhood of these ulcers is always in a state of inflammation ; and the same may be said of the periosteum, which is either red and thickened, greatly indurated, or even converted into fibro-cartilage. Cases occur, in which the osseous tissue, although slightly softened, is in reality very porous and brittle, owing to an inordinate deposition of earthy matter. This form of the disease, which seems to affect only the broad bones, is generally attended with little discharge, and hence the ancients were in the habit of calling it "dry caries."

The matter which attends ulceration of the osseous tissue is commonly of a thin, watery, ichorous nature, highly irritating to the soft parts, and of an offensive odor. It always contains a large amount of earthy salts, on which account the instruments used in dressing a sore of this kind are usually stained black, especially if made of silver. When granulations sprout up, as is always the case when the ulcer manifests a disposition to heal, the matter becomes less acrid, more copious and consistent, and, as the recuperative process advances, it assumes all the properties of laudable pus.

There are few topics connected with the diseases of the bones which are more interesting than that of *gangrene*, whether we regard the facility and frequency of its occurrence, or the various phenomena which attend its progress and termination. The disease may occur at any period ; but, in the generality of cases, it comes on between the fifth and the twentieth years,—seldom before, and still more rarely after. The parts of the osseous system which are most frequently affected are the tibia, clavicle, inferior maxilla, femur, ulna, radius, and fibula, though no bone in the body is, perhaps, entirely exempt from it.

Necrosis may be partial or entire, simple or compound ; that is, it may affect merely a part of a bone, or it may pervade its

whole structure ; and, again, it may be limited to one bone, or it may attack several bones simultaneously, or several different parts of the same bone. The causes of the complaint are either local or general, and are not essentially different from those which lead to gangrene in the soft textures. Amongst the local causes may be enumerated wounds, contusions, fractures, and chemical irritants ; amongst the internal, a scrofulous, or venereal taint of the system, the long-continued use of mercury, and the effects of protracted and debilitating febrile diseases. But a much more frequent source, perhaps, of necrosis than any other that I have yet mentioned, is exposure to cold. This, at least, seems to be the way in which children generally contract this disease in this country. A boy, for example, with his body perfectly heated, suddenly plunges into the cold water, and thus at once checks the perspiration. He retires to bed in good health ; but, towards morning, he is roused from his slumbers by a severe pain in his tibia, clavicle, or radius. The skin next becomes flushed, the part is tender on pressure, and finally there is a circumscribed tumor formed, which, ulcerating, gives vent to a thin, saious fluid, similar to that which, attends caries. All these phenomena indicate that there has been osteitis ; and, if the bone be carefully inspected, a considerable portion of it will be found to have perished. When thus induced, the complaint is often extremely rapid in its progress, and soon comes to a crisis.

It has been stated that necrosis is sometimes partial, or, in other words, limited to a part of a bone. In such cases, death usually arises from external causes, as a blow or contusion, or from denudation, and rarely extends beyond the outer compact structure. Exfoliation is not a necessary consequence of a bone that is stripped of its periosteum. If it be in other respects healthy, and enjoy a vigorous circulation, granulations will spring up and gradually repair the breach. If the denudation, however, be very extensive, even although the bone should be perfectly sound, exfoliation will be very apt to take place, owing to the injury which has been inflicted upon the capillary vessels of the part. The exposed part, supposing that the disease has been occasioned by a removal of the periosteum, remains white and dry, and after some time *exfoliates*, or comes away in one or more thin scales, plates, or lamellæ. The surface from which the separation has been effected is covered with florid granulations, which by degrees

assume the ossific process, and thus finally replace, either in part or entirely, the lost substance. The exfoliated bone is either white, grayish, or of a light brownish color, rough, often very porous, and so brittle as to fall to pieces under the slightest pressure of the finger. No vessels can be perceived in it, and the animal matter seems to be almost wholly abstracted. By maceration, its dark color gradually disappears; and, by immersion in dilute nitric or muriatic acid for a few days, its texture is completely broken up, being converted into soft, sandy particles.

When necrosis pervades the whole thickness of a bone, as it is apt to do when it follows caries, exposure to cold, small-pox, or measles, the process of separation is much more complex and tedious, months often elapsing between the death of the part and its final exit from the body. The first step in the process is the formation of a sort of osseous shell, which seems to be designed to answer as a temporary substitute for the old bone, at the same time that it serves to isolate it from the surrounding parts. Let us inquire how this is effected; how an organ which has so greatly suffered is repaired? The dead bone acting as an irritant or an extraneous body, excites inflammation in the circumjacent structures, which become thickened and pour out coagulating lymph, similar to that which is effused around the extremities of a fracture. After some time, varying according to the age and vigor of the patient, this substance acquires the properties of cartilage, and this again, in its turn, is finally replaced by osseous matter, arranged in the form of an irregular shell, from one to three lines in thickness. In this shell one or more holes are left, which communicate, by means of sinuses, with the surface of the limb, and form the channels through which, in the common course of events, the dead bone, which is now named the *sequestrum*, is ultimately to be expelled. Whilst thus situated, the eschar is bathed either in thin, fetid, sanguous matter, or in thick, white, inodorous pus; and a part of it is almost always absorbed by the vessels of the new bone, in the same manner, it may be supposed, as the fang of a dead tooth is absorbed by the gum which surrounds it. The surface of the sequester is usually rough, excavated, or honey-combed, and its color either grayish, brownish, or black. In the cylindrical bones, it is almost always more or less dense and dry; whereas, in the short, it is commonly porous, remarkably brittle, and moist.

As soon as the sequester is removed, whether by nature or by art, the temporary shell contracts, and by degrees assumes the form of the old bone which it is designed to replace. Whilst this change is going on externally, osseous matter is deposited upon the inner surface of the shell, and upon the extremities of the surviving portions; and in this manner the vacant cavity is finally filled up, the time required being always in proportion the size of the eschar. The medullary canal, in case there was one previously, is seldom re-established; and the new bone, although it remains for a long period highly vascular, is not able to withstand the effects of inflammation so well as the original.

Are bones ever completely regenerated? Respecting this occurrence various opinions have been expressed by pathologists, some denying, others strenuously contending for the possibility of it. The question, it is obvious, can only be decided by observation; and, if this be taken as our guide, few writers will ever be able to determine the matter for themselves. Here, as in many other obscure points in pathology, a candid appeal to facts, as they have been recorded by physicians, will do infinitely more than a thousand conjectures. The testimony of the older writers, unfortunately, is of little avail, as they were in the habit, too frequently, of distorting facts to suit their own theories. The same objection arises against some of the moderns; still there are many exceptions, and from these we must draw our information. All parts of the skeleton do not seem to be equally capable of reproduction. The short and broad bones are much more rarely regenerated than the long; and among the latter the occurrence has been much oftener witnessed in the tibia than in any other of the cylindrical pieces. Moreau saw a case of complete regeneration of the clavicle; Chopart, of the scapula; Fowles, of the ulna; and Weidemann, of the lower-jaw. In 1832, I had an opportunity of seeing an Irish lad, from whom Dr. Cusack, of Dublin, had, about four years previously, removed the left half of the inferior maxilla, on account of an osteo-sarcomatous affection. In this case, nature had made an attempt at reproduction, though it was still imperfect at the time I made the examination, the part being replaced by a thick, rounded piece of cartilage, sufficiently strong, however, to subserve the ordinary purposes of mastication. Not long since, a young man showed me the upper half of his astragalus, which had sloughed away several years ago; yet he had

the perfect use of his ankle, which can only be explained on the ground of a perfect reproduction of the necrosed bone. At the time I saw him, the ulna of the left arm was in a state of gangrenous inflammation.

No doubt can therefore be entertained, it seems to me, respecting the possibility of bones being regenerated. For my own part, I am fully convinced of it, and feel assured that whoever will candidly investigate the subject will come to a similar conclusion. At the same time, there is reason to believe that the occurrence is extremely rare; and no account should be received as true, unless it be vouched for by respectable authority.

The symptoms of necrosis do not differ, at first, materially from those of caries; and the diagnosis can seldom be determined with any degree of certainty until there is a discharge of dark-colored splinters, or until some of the dead fragments protrude through the opening in the soft parts, or are visible on separating its edges. When these phenomena are present, there can be no doubt of the nature of the disease; but, in cases of an opposite character, the diagnosis is sometimes extremely difficult. In such cases, a careful examination should be made with the index-finger; or, where this is impracticable on account of the tortuous course of the sinuses, or the narrow state of the ulcerated orifices, a probe should be employed, with which the condition of the bone should be accurately ascertained.

Softening of the bones was first noticed as a distinct disease in 1688, by Gabriel. More frequent in the female than in the male sex, it occurs almost exclusively in adults, and has been known, in a few instances, to involve the whole skeleton. Of this, the woman Lussiot, whose case is described in the *Memoirs of the Royal Academy of Paris* for 1752, affords a memorable example: her bones were so soft that they could be bent like wax, and put in almost any position. In a case described by the late Mr. Wilson, of London, the only pieces which escaped this disease were the sacrum and the bones of the foot. More generally, the lesion is confined to particular bones, being especially apt to occur in such as are largely supplied with spongy matter.

The osseous tissue in this affection loses its firmness and consistence, becomes soft and pliant, and may be easily cut with the knife. It is of a pâle reddish color, often inclining to yellow, is specifically lighter than the healthy structure,

and is infiltrated with a turbid, viscid serum, removable by pressure. Occasionally, the osseous fibres are widely separated from each other, so as to leave large cells, which are filled with a bloody-looking, adipous substance. When this is the case, the bone is sometimes remarkably pliant, bending like semi-concrete wax. Boiling completely dissolves it; and exposure to the air, by abstracting its moisture, diminishes its weight. Such are the principal changes observable in the osseous tissue. The periosteum over the affected part is pale and extenuated; the marrow is converted into a reddish, greasy sanies; and the medullary membrane is wasted down to a few soft, cellular shreds.

The softening generally involves the whole thickness of the bone; but cases sometimes occur in which the outer table remains unchanged, consisting of a thin, brittle shell. The disorder obviously consists either in an inordinate absorption of the phosphate of lime, upon which the solidity of the osseous structure depends, or in a deficient deposition of this matter into its meshes. It has been already mentioned, that the bones become specifically lighter in this disease; and Dr. Bostock has ascertained the additional fact that they contain nearly eighty parts of animal substance in the hundred. The causes of this change are buried in entire obscurity. Does it depend upon inflammation? Mr. Gendrin thinks it does not, and assigns quite a number of reasons in support of his opinion. But do not all the phenomena of this affection indicate the reverse of this theory? Let the student compare the anatomical characters of ostitis and softening, and see if they do not strikingly resemble each other. We do not, by this, wish to be understood to mean that softening is caused by active inflammation; all that we are anxious to convey is, that the disease in question is the result of a slow, chronic irritation, leading to lesion of nutrition in the osseous tissue. It is seldom that this disorder is attended with any pain; and this may be regarded as another argument in favor of the opinion that it does not depend upon acute inflammation.

The bones are liable to become preternaturally brittle, crumbling to pieces under the most trifling accidents. The disease, which is technically called *fragility*, is most commonly found as an attendant on old age, and is seldom restricted to any particular class of bones, though the cylindrical are perhaps most prone to it. The cause of this singular affection has been a source of much theoretical discussion.

The best writers, however, agree in referring it to a lesion of nutrition, produced by a diminution of the number and volume of the vessels of the osseous tissue. The validity of this opinion derives great plausibility from a contemplation of the changes which the bones undergo in the different periods of life. In childhood, the osseous tissue is remarkably flexible and pliant, and contains a large amount of animal substance; in old age, on the contrary, it is very dense, hard, calcareous, and extremely liable to break, the slightest exertion or accident being often sufficient to cause this result. The number of fractures that are sometimes produced in this way, even in young persons, is truly astonishing. M. Devergie* states that he dissected a female, in 1818, who died under symptoms of fragility, in whose skeleton he found not less than eighty-three fractures. Dr. Gibson gives the case of a young man, nineteen years of age, in whom the bones of the arm, fore-arm, thigh, and leg, have all been repeatedly broken, from the most trivial causes. The clavicles have suffered still more frequently, having been fractured eight times. Fractures from this cause sometimes occur in the foetus in the womb. Chaussier has related a remarkable example of this kind, in which each of the long bones presented one or more of these lesions, some of which were recent, others beginning to unite, whilst others were consolidated. The child survived its birth only twenty-four hours. Some-what similar cases have been reported by Gardner and Glogengieser.

Bones affected with this disease are sometimes completely saturated with oily matter, which renders them unfit for preparations; but, in most instances, they are dry and brittle, and crumble to pieces under the slightest pressure. In the latter stages of scurvy and scrofula, they become often extremely fragile; and, if they be boiled, they break down into thin, irregular scales, or are almost entirely dissolved. The disease is rarely attended with any pain, and the general health is usually remarkably good. When fractures occur, they sometimes rapidly unite; at other times, however, restoration does not take place, or only after a very long period.

Hypertrophy of the osseous tissue in different parts of the body may be either partial or general; that is, the abnormal growth may affect either a portion or the whole of a bone.

* Dictionnaire de Med. et Chirurg. Practique, t. x. 1833.

The latter, however, is a very rare occurrence, though perhaps not so much so as has been generally imagined. Cases, indeed, not infrequently occur, in which the broad bones of the head present an extraordinary degree of developement, being more than an inch in thickness, and so hard that it is almost impossible to saw them through. Under these circumstances, the two tables are extremely compact, and the intermediate spongy structure is totally obliterated, or rather replaced by dense, earthy matter. Similar appearances are sometimes witnessed in the cylindrical bones of the extremities. In an old femur in the museum of morbid anatomy in the Cincinnati College, the medullary canal is scarcely large enough to admit a common-sized quill; and the whole shaft seems to consist almost entirely of compact substance, in many places more than six lines in thickness. The bones of the male are always larger and more distinctly developed than those of the female; and the bones of persons who take severe and constant exercise, than those who are indolent, or make but little exertion. By labor, their weight and dimensions increase; their spongy structure diminishes, whilst the compact becomes harder, of a closer grain, and acquires an almost rock-like solidity; the muscular prominences are rendered more conspicuous;—in short, every thing indicates that they are in a state of general hypertrophy. When thus circumstanced, the osseous tissue usually contains a due proportion of animal matter; and hence it is always capable of resisting, in a very eminent degree, the influence of such agents as have a tendency to injure it.

When the hypertrophy is partial, it constitutes what is called an *exostosis*,—a Greek term, literally implying an exuberant growth of bony matter. Tumors of very opposite characters have been described by writers under this head, and, as might be expected, much confusion has been the result. To avoid this, if possible, in the present instance, I deem it necessary here to state that, by the word *exostosis*, I understand, in common with the best pathologists of the day, simply a bony excrescence, similar in its structure to the osseous tissue in its normal condition. Nothing can be more unscientific, it seems to me, than the classification proposed by Sir Astley Cooper, who has described under this head some of the most malignant diseases to which the bones are subject.

The bones most commonly affected by this species of

hypertrophy are the femoral, frontal, parietal, and lower-maxillary,—the relative frequency of its attack being in the order here stated. No part of the skeleton, however, appears to be exempt from it; and, in a few instances, it has been known to affect a large number of pieces at the same time, as if there had been an exostotic diathesis. Great variety prevails in regard to the size and shape of these tumors. In most instances, they look like small, irregular excrescences, with a rough, scabrous surface; but sometimes, especially when they are seated on the flat bones, they are of a spherical form, and nearly or quite smooth. In other cases, again, they have a mammillated appearance; or they form flat discs, resting upon a short, narrow pedicle; or, finally, they are rounded, nodular, or knob-like. Their size seldom exceeds a small apple, orange, or potatoe, though examples are occasionally met with, where they are as large as a cocoanut or a foetal head. In a specimen in our museum of morbid anatomy, the walls of the left maxillary sinus are literally studded with these growths, none of which exceeds a small grain of wheat, which they also very much resemble in shape.

In their structure, exostoses present all the varieties of the natural bone upon which they grow, being composed of a soft, spongy texture, enclosed by a layer of solid, compact matter. Occasionally, they are surrounded by a coat of cartilage; and very frequently they have all the firmness and density of ivory. In the healthy state, they are perfectly insensible; but they are susceptible of inflammation; and it is probably when laboring under this disease, that they experience those changes which have obtained for them the names of fungous, medullary, and cancerous, so much in vogue amongst some surgical writers.

These tumors are formed in the same manner precisely, as the osseous tissue in other parts of the skeleton, passing always through the same stages of ossification. That this is the case, will appear sufficiently obvious, if we refer for a moment to the causes by which they are produced. Amongst these, the most common, perhaps, are the various kinds of external violence, such, especially, as blows or contusions; though many contend for a scrofulous, gouty, or syphilitic origin. Induced in any of these ways, there must be local inflammation, either in the bone, or in the periosteum, or in both,—one of the effects of which is an effusion of

coagulating lymph. This, after some time, is converted into cartilage, and this finally into bony matter.

Some exostoses are extremely rapid in their growth, and soon attain a very considerable magnitude; most commonly, however, their developement is gradual, going on for many years without causing any serious inconvenience. They are seldom attended with much pain; indeed, it is only when they are very large or when they degenerate into cancerous affections, that they become a source of local annoyance and constitutional disturbance. Youth seems to be the period in which these growths are most frequent, though adults and old persons are by no means exempt from them.

In *atrophy*, the osseous tissue undergoes partial absorption, as is evinced by its abnormal softness, lightness and porosity. The portions of the skeleton most obnoxious to this change are the long bones of the extremities, the compact structure of which is often remarkably diminished in consistence and thickness. In the museum of the Cincinnati College, are the cylindrical bones of the arm, fore-arm, thigh, and leg, of a colored woman, about forty years old, who died of tubercular phthisis, which are reduced to mere shells, the cortex of several of them being scarcely as thick as wrapping paper: they are all extremely light and brittle; and, during the maceration which was necessary to clean them, they became so soft that they could be easily cut with the knife. The medullary canal was much enlarged by an absorption of its spongy texture, and contained a greasy, reddish substance, not unlike fresh adipocire.

Pressure, steadily exerted for a considerable length of time, has a tendency to produce atrophy in the osseous tissue. This is well exemplified in the cranial bones, in tumors of the dura mater; in the sternum and the dorsal vertebræ, in aneurism of the aorta; and in the ribs, in cancer of the breast. In all these cases, the compact substance is reduced to thin, translucent plates, whilst the spongy texture is either wholly destroyed or worn down to a few slender threads. In old age, the bones are usually deprived of a part of their weight; their muscular prominences are partially wasted; and they no longer contain the same amount of animal matter, nor the same number of vessels and nerves. In painful and protracted diseases, the bones seem to partake of the general emaciation; and, in limbs that have been long ankylosed or paralysed, they are often sensibly diminished in size and weight.

The bones are occasionally the seat of *hydatids*, occurring either separately or in small clusters. Their walls are extremely delicate, transparent, and slightly vascular ; and their contents, which are thin and limpid, are coagulable by heat, alcohol, and acids. They seem to be true acephalocysts, are generally of a globular form, and vary in size and number in different cases, being usually larger when there are only a few than when there are many.

The seat of this malady does not seem to be restricted to any particular class of bones, though the long ones are perhaps most subject to it. Its causes have not yet been satisfactorily investigated ; nor are its symptoms such as to enable us, in the present state of our knowledge, to distinguish it from other affections. In the instructive case related by Mr. Keate, of London, to whom we are indebted for the first accurate account of the nature of this rare disease, the hydatids were developed in the frontal bone, which formed a tumor immediately over the left eye, about the size of an orange. The patient was a young female, and the complaint had been coming on for a number of years.* In another case, mentioned by Cruveilhier, the disease was seated on the anterior part of the tibia, and had the appearance of an indolent steatomatous growth, with a hard, irregular border. On being laid open, it gave vent to a thick inodorous fluid, resembling the dregs of wine. One of the most singular features of these cysts is their indestructible nature, being almost sure, unless completely destroyed, to be speedily regenerated.

Another very rare and singular disease of the osseous tissue, which, in many of its phenomena, closely resembles the anastomotic aneurism of the soft parts, has been recently pointed out by M. Breschet, an eminent pathologist of Paris.† The complaint has since attracted the attention of other writers, and in my work on the diseases of the bones and joints it has been described under the term *osteo-sanguineous*, as most expressive of its true nature and character. It has hitherto been witnessed chiefly in young subjects ; and its most common situation is in the vicinity of the knee-joint, implicating the cancellated structure of the upper extremity

* Medico-Chirurg. Transactions, vol. x. p. 178; London, 1819.

† Observations et Réflexions sur les Tumeurs Sanguinées des Os ; Répertoire Générale d'Anatomie, &c. t. ii. Paris, 1826.

of the leg bones. The tumor varies in size in different cases, being sometimes small, sometimes large. In an instance mentioned by Mr. Bell, of Edinburgh, it measured more than nine inches in circumference, and more than six in length.

The cellular texture of the diseased bone is either partially or wholly destroyed, and its medullary canal is enlarged and filled with coagulated blood, disposed in concentric layers, as in old aneurisinal tumors. These clots form one or more cavities, each of which communicates with a number of small arteries. Sometimes the blood is partly fluid, and partly coagulated; but, in the majority of cases, it exhibits the appearance that has just been assigned to it.

The external table of the bone is considerably attenuated, in many parts destroyed, and in some so flexible and elastic that it may be bent like cartilage. Very often, however, the part is extremely brittle, and may be crushed like the shell of an egg. The periosteum is generally thickened and indurated; but the joints which are situated in the immediate vicinity of the disease are commonly healthy, even when they are separated from it merely by a thin layer of cartilage. The vessels which ramify through the substance of the bone are usually tortuous and brittle, increased in size, and open, as already stated, by numerous little orifices into the aneurisinal sac in the centre of the diseased mass, as may be shown by filling them with minute injecting matter.

The causes of this lesion are still involved in great obscurity, nothing being known with any certainty concerning them. In some instances, it has been attributed to a blow; in others, to a fall or jump from a considerable height. Either of these causes, by disturbing the vascular action of the bone, might produce the disease. Occasionally it is connected with a gouty or rheumatic diathesis, and then it probably depends upon inflammatory irritation.

An osteo-sanguineous tumor is tense, painful, and tender on pressure. When fully developed, a deep-seated pulsation is observable in it, which is isochronous with that of the heart, and somewhat similar to the motion which is imparted by an anastomotic aneurism of the face. By compressing the main artery of the limb above the tumor, the pulsation ceases, reappearing immediately when the pressure is removed. This is an important fact, which may be regarded as diagnostic of the nature of the disease.

Cartilaginous tumors are sometimes developed in the

spongy texture of the bones, or upon their outer surface. Their growth is generally rapid, and the pain which attends them considerable, sometimes very severe. The disease which is usually described under the vague name of *osteo-sarcoma*, is always of a malignant character, and seems to have a peculiar predilection for the bones of the extremities, and for the upper and lower-jaw. The tumor is commonly of a globular form, with a rough, nodulated surface, and not infrequently attains an extraordinary magnitude. It is firm, dense, and elastic like cartilage, of a light grayish color, and contains a vast number of minute oblong cells, filled with a reddish, gelatinous fluid. In general, small spicules of bone are dispersed through it ; and, in most cases, it is surrounded by a thin, porous shell, so soft that it may be cut without blunting the knife. Occasionally, the tumor is hard, and fibrous, or red and dense, like half-boiled beef, or fresh pork.

Another variety of *osteo-sarcoma*, but of a still more formidable character, because more malignant, is the *encephaloïd*, the fungus *hæmatodes*, or soft cancer of surgical writers. It generally, if not always, originates in the spongy structure, probably from inflammation of the medullary membrane ; and it most commonly attacks the long bones of the extremities, especially the tibia and femur, also the digital phalanges. No portion of the skeleton, however, seems to be exempt from it. Mr. Mayo has seen it in the ilium, the cranial bones, the sternum, and ribs ; and others have witnessed it in the clavicle, the scapula, the lower-jaw, and dorsal vertebrae. The most terrific feature of this disease is its tendency to recur in some other part of the body, after it has been dislodged from its original situation. On this account it is almost always fatal. It may occur at any period of life, but children seem to be most prone to it. Its progress is often frightfully rapid, and the sufferings which it occasions truly agonizing.

The tumor is generally disposed in rounded and lobulated masses, of the color and consistence of the medullary substance of the brain. Very frequently it contains small cavities, which are filled either with clotted blood, with dirty looking serum, or with soft, gelatinous, oily, sebaceous, or melliceric matter. Occasionally one part of the tumor presents the brain-like character, whilst the other has all the appearances of a dense coagulum ; but, in the majority of cases, these two substances are pretty intimately blended together.

Vessels can often be seen ramifying over the surface of the morbid growth, but very few can be traced into its substance, at least not to any great depth. As in the preceding variety, so in this, the outer table of the bone is often expanded into a mere shell, or is even entirely destroyed by absorption. The skin is at first soft, glossy, and marked by numerous veins, which meander through it in various directions; but, at length, from the constant pressure which is exerted upon it, it ulcerates, and allows the fungous mass to protrude and give vent to its foul discharges.

Melanosis is sometimes met with in the bones; but the occurrence, I presume, is extremely rare, and I have never seen an example of it. It is deposited sometimes in small disseminated masses, sometimes in delicate nodules or clusters, sometimes in the form of infiltration. Mr. Halliday, an English physician, has reported an interesting case in the London Medical Repository for 1823, in which the melanotic substance was diffused through the spongy texture of the parietal and occipital bones, the sternum, and ribs, dying them, in a great part of their extent, of a deep black color. In the generality of instances, however, the disease is developed in the long bones, particularly in the femur and tibia. In its progress and mode of termination, it closely resembles osteo-sarcoma, its nature being decidedly malignant.

Tubercles of the bones, although not of very frequent occurrence, are yet sufficiently common to render them objects of particular interest to the pathologist. From the recent researches of some of the French anatomists, especially of Nichet and Nélaton, there is every reason to believe that what is named Pott's disease is owing, in most cases, to the development of these bodies. Nor are these heterologous formations always confined to the vertebræ: in many instances they affect the short bones in other situations, and they seem to be very often deposited in the articulating extremities of the long ones. The particular seat of tubercles is the spongy texture, though occasionally they are formed upon the outer surface of the bones, between it and the periosteum.

There are two varieties of form in which this matter may be deposited. In one, perhaps the most common, the tubercles are *encysted*, the enclosing membrane, which varies in thickness from a fifth to half a line, being composed of coagulating lymph, very soft at first, but gradually becoming harder and harder, until finally, in some cases, it acquires the

character of fibro-cartilage. It is of a dull grayish color, is made up of delicate, inelastic fibres, crossing each other in every conceivable direction, and is furnished frequently with small vessels, passing into it from the surrounding structure. The number of tubercles is seldom very great; their size varies from that of a pea to that of a nutmeg; and in most cases they present a yellowish, opaque appearance. Occasionally these bodies become softened, when the matter will either work its way out, or pass, by a sort of fistulous route, into a neighboring joint, establishing thereby an analogy with pulmonary tubercles opening into the bronchial tubes. Sometimes a spontaneous cure takes place, the heterologous substance being absorbed, and the cyst contracting so as to obliterate its cavity.

In the second variety, the tubercular matter is deposited directly in the cells of the osseous tissue, forming grayish, semi-transparent, opaline patches, from one sixth of an inch to an inch in diameter. This infiltration has hitherto been noticed chiefly in the bodies of the vertebræ, and, what is remarkable, is frequently pervaded by numerous vessels, too delicate to be discerned with the naked eye. The bony tissue immediately around is sometimes deeply injected, but seldom otherwise diseased. In this, as in the preceding variety, the tubercular deposit, after having existed for some time, gradually softens, its vascularity disappears, and the cells in which it was contained are filled up with earthy matter. This, however, is not always the case; for now and then the ulcerative process continues until the bone is totally destroyed.

SECTION II.

Of the Periosteum.

THE outer surface of the bones is every where closely invested, excepting at their articular extremities, by a tough, fibrous membrane, which is hence called the periosteum. In its structure, it strictly resembles the dura mater the pericardium, and the aponeurotic sheaths of the muscles, being, like them, composed of strong, dense, and inelastic filaments,

which are matted together in the firmest and most inextricable manner. Of the two surfaces which this membrane presents, the external is rough, and covered by a small quantity of cellular substance, by which it is connected to the surrounding textures: the inner, although not perfectly smooth, is much less flocculent than the other, and is joined to the bones by an immense number of little slender processes, which extend into the osseous tissue, and serve to transmit the nutrient vessels. In certain regions of the body, as in the mouth, nose, ear, and sinuses of the head, the periosteum is in immediate contact with the mucous membrane, to which it adheres with extraordinary tenacity. It consists every where of a single lamella, the thickness of which varies from the fifth of a line to the twelfth of an inch, according to the age of the subject, and the situation in which it is located.

The periosteum has a plentiful supply of blood-vessels, which are derived from the adjacent branches, and which freely anastomose with those of the bones. Its nerves and lymphatics are few in number, and so excessively delicate as to elude the unassisted eye. In health, the membrane possesses little sensibility; but, when under the influence of inflammation, the patient suffers the most acute pain, which is often relieved by dividing the diseased texture.

In infancy, this membrane is soft, thick, and spongy, and may be readily detached from its connections. In adult life, it is more firm and compact, and adheres so intimately to the bones that it is separated with difficulty. In old age, it is extremely tough, and not unfrequently ossified on its internal surface. Its vascularity, which is at first rather obscure, also gradually increases as we advance in years, but again diminishes in old age. The color of this membrane is likewise subject to considerable variation. In the young it is of a lilac tint, which becomes lighter towards middle life, and is finally replaced by a dull white. In persons who die from asphyxia, the color of the periosteum is generally a few shades deeper than in such as perish from lingering diseases.

The morbid relations of the periosteum, although not unlike those of other fibrous textures, are too important to be passed by without due notice. The most common lesion to which this membrane is liable is chronic inflammation, followed by thickening, and the deposit of osseous matter, generally upon the internal surface, but occasionally upon

the external. Acute inflammation is also frequently observed, and seldom exists without implicating the subjacent bone.

Inflammation arises either spontaneously, from external injury, or from the operation of the syphilitic poison. In the acute form of the disease, the membrane becomes reddened, its vessels are loaded with blood, and its substance is sensibly softened as well as slightly thickened. Its attachment to the bones is also considerably diminished, so that it can be much more easily peeled off, and the cellular substance on its external surface is generally infiltrated with sero-albuminous matter. These changes are frequently observed upon the fragments of a broken bone, and in incised wounds of the muscles, involving the periosteum.

This disease, especially the acute form of it, not unfrequently passes into suppuration. This event is more particularly apt to occur in periostitis of the inferior extremity, caused by the influence of cold upon a strumous constitution, or by the effects of mercury, or the action of the syphilitic virus. In either case, the suppurative process is remarkably tardy, and the pus is rarely of a healthy character, but almost always very thin, bloody, and offensive, with flakes of curdy matter. As the fluid accumulates, the superincumbent integuments assume a red, glossy, and swollen appearance; the part is excessively painful; fluctuates distinctly under the pressure of the finger; and, when the abscess is laid open, the corresponding portion of the bone is usually found to be destroyed by ulceration.

Another termination of acute inflammation is mortification. When this occurs, the normal appearance of the membrane is lost, and changed to a dirty ash-color, whilst its texture is softened, easily torn, and bathed in a foul offensive fluid, having the characteristic gangrenous odor. This termination, it need scarcely be observed, can never take place without the osseous texture participating in it. The best examples of it are witnessed in the periosteum of the alveolar processes of the jaws, from the abuse of mercury, and in that of the tibia from common necrosis. The sloughs, which are always tough and shreddy, are usually thrown off with considerable difficulty, owing to the tardy and imperfect action of the circumjacent structures.

When the periosteum labors under chronic inflammation, it is very apt to become thickened, from the effusion of plastic lymph. The hypertrophy, for so it may be termed, generally

occurs in association with induration, and often involves a considerable extent of surface, forming a diffuse, incompressible swelling, partly fibrous, partly cartilaginous, and partly osseous. In other cases, the hypertrophy is more circumscribed, and either exhibits the mixed structure just specified, or it is entirely bony. These tumors are commonly of slow formation, and they seldom acquire any great bulk. During the progress of their developement, they are the seat of a constant, deep-seated, gnawing pain, which is most severe at night, when the body becomes warm in bed. After continuing for an indefinite period they either remain stationary, or they gradually disappear by absorption, or they excite suppuration in the super-imposed textures.

In old people, nothing is more common than to find this membrane ossified upon its internal surface, or even through its entire substance. When thus affected, the periosteum is of a dull drab color, resists the knife, and is with difficulty detached from the bone which it covers, owing to the partial incorporation of their tissues. When dried, it exhibits very much the appearance of an ossified artery. In the extremities, especially in the thighs, I have frequently seen considerable nodules of bone spring from the outer surface of this membrane, so as to encroach more or less upon the muscles. In their shape, they are, for the most part, ovoidal, and in their consistence they fully equal the petrous portion of the temporal bone. Their color is usually a few shades lighter than that of the osseous texture in the healthy state.

The periosteum has been found affected, in a few rare cases, with melanosis; and occasionally, also, with the tubercular deposit. In carcinoma of the bones, the membrane is often implicated secondarily, but it is rarely, perhaps never, the original seat of this formidable malady. In a number of dissections which I have made of encephaloid disease of the bones and soft parts, I have found the periosteum entirely untouched, not even thickened or indurated. Hence we may infer that this fibrous lamella possesses an astonishing self-preserving power, much superior to what is enjoyed by most other tissues.

SECTION III.

Of the Medullary Membrane.

THERE is another structure, which, from its important relations with the bones, demands a few remarks before we finally close the present chapter. I need scarcely say that I allude to what is called the medullary membrane.

This delicate and beautiful structure is generally described as being entirely restricted to the canals of the long bones,—an opinion which is not easily explained, when it is recollect- ed that the cells of the areolated texture of these organs are constantly filled with adipous matter, which it is the proper office of this membrane to elaborate. True, it is not so easily demonstrated in the latter as in the former situation; but the fact just referred to amply proves that it must exist there; otherwise it would be impossible to account for the presence of *adeps*. To display the medullary membrane, it is necessary to saw one of the cylindrical bones in the longitudinal direction, and then plunge it into boiling water, or expose it to the action of some dilute mineral acid. The membrane will thus become detached from the parietes of the internal canal, and adhere to the adipous substance, so as to appear perfectly distinct. If it be now carefully inspected, it will be found to be essentially composed of cellular tissue, blood-ves- sels, nerves, and lymphatics. It is pierced by a multitude of minute foramina, and is so thin and delicate as to bear a striking resemblance to a spider's web. It is connected, on the one hand, to the parietes of the bones by very thin and slender processes; and, on the other, it detaches an immense number of septa, which, by their interlacement with the inter- nal cancellated structure, and with each other, form a vast mul- titude of cells, similar to those of the adipous tissue in other parts of the body, both as respects their structure and func- tions. The sensibility of this membrane is very obscure in the normal state; and it is so delicate as to be very easily torn.

Of the diseases of the medullary membrane, not enough is known to enable us to speak with any degree of decision. Acute inflammation is extremely rare, and is observed principally in fractures of the long bones. The membrane in this

form of the lesion assumes a reddish tint, and the secretion of fatty matter is not only temporarily suspended, but that which existed prior to the occurrence of the accident is generally absorbed. In violent cases, pus is effused, and forms an abscess in the interior of the bone. In necrosis, the medullary membrane, corresponding with the affected portion of bone, loses its vitality, and is gradually broken up into a dark-colored, oily putrilage, of a fetid, gangrenous odor.

Chronic inflammation of this membrane, I have recently seen in the tibia and fibula of a man sixty years of age, who died from the effects of a sloughing ulcer, brought on apparently by intemperance. Both bones were in a state of necrosis at their middle; inferiorly they were greatly expanded, but towards the knee they were of the natural dimensions, and contained a red, florid-looking marrow, of preternatural hardness. The discoloration, however, was not uniform, but occurred in distinct patches, varying in diameter, from that of a pea up to that of a twenty-five cent piece.

Since the adipous tissue of the bones bears the greatest resemblance to that in other parts of the body, it is highly probable, I think, that it possesses certain modifications of structure, leading to corresponding peculiarities in reference to its diseases. That this is the case, I am disposed to believe, from the fact that the medullary membrane is not unfrequently the seat of several of the heterologous formations, such as the scirrhouss and encephaloïd, which are never developed. So far as I know, in the adeps of the general system, the tubercular matter is also sometimes deposited here; and another argument in favor of this view is founded upon the notable difference in the products of the two tissues, that of the bones being always of a thin, oily nature, and composed principally of elaine, the other, semi-concrete, and formed mainly of stearine.

CHAPTER X.

Of the Cutaneous System.

SECTION I.

Of the Skin.

I. *The Skin.* — Number of Layers. — Epidermis. — Mucous Web. — Dermis. — Papillæ. — Sudoriferous Glands. — Sebaceous Follicles. — Reproductive power of the different lamellæ of the Skin. — Diseases. — (I.) Unclassifiable Lesions. — Keloid. — Melanosis. — Encephaloïd. — Cartilaginous Tumors. — Eiloïd. — Lepoid. — Hypertrophy. — Corns. — Warts. — Horny Excrencences. — Gangrene. — Sebaceous Tumors. — Hemorrhages. — (II.) Classifiable Lesions. — 1. Exanthematous Diseases. — 2. Pustular. — 3. Papular. — 4. Bullar. — 5. Tubercular. — 6. Scaly. — 7. Syphilitic Diseases. — 8. Stains. — II. *The Nails.* — Situation, Composition, and Arrangement. — Growth. — Reproductive Power. — Inordinate Length. — Absence. — Malformation. — Vicious Situation. — Onyxitis. — III. *The Hairs.* — Similarity to the Nails. — Situation. — Consist each of a Follicle and Stem. — Organization. — Polish Plait. — Regenerating Power. — Hypertrophy. — Female Beards. — Softening. — Fragility. — Changes of Color. — Accidental development of Hair.

WITH the situation and appearance of the skin all are familiar. Forming the general envelope for the body, it answers the same purpose to the outer surface, that the mucous membranes do to the excretory canals, into the openings of which it dips, so as to participate in their structure. Varying in thickness, from the sixth of an inch to the third of a line, it presents considerable diversity not only in different regions, but likewise in the different periods of life, being extremely soft and delicate in infants, more firm and resisting in adults, flabby and wrinkled in old age. It is also more delicate in the female than in the male, and in health than in disease, when it is frequently hard, dry, and shriveled.

Much contrariety of sentiment still exists among anatomists respecting the precise number of layers of which the skin is composed, — some, as Chaussier and Gordon, asserting that there are only two; some, that there are three; some, that there are four; and others, again, that there are as many as five, six, or even seven. The second of these opinions, how-

ever, is that which has received the greatest number of advocates, and is the one, moreover, which accords best with the results of my own dissections. Adopting this view, we shall find that the external tegument is made up of three distinct strata, — an outer, middle, and inner, the first being named the cuticle, the second the mucous web of Malpighi, and the third the dermis or true skin.

The *cuticle*, also called the epidermis, or scarf-skin, is the most superficial layer of the three, being spread over the mucous web like a thin varnish of gum shellac. Of a dull white color, it is elastic, hygrometric, transparent, and so yielding in texture, that it readily tears. It is rendered yellow, and finally dissolved by immersion in nitric acid, swells a little when macerated in water, emits a peculiar animal odor on being exposed to a red heat, is nearly impetrascible, and is composed principally of albumen, with a small quantity of gelatine and salts.

The epidermis consists every where of a single lamella, excepting in the sole of the foot, where, from mechanical pressure, it is frequently separable into several distinct layers. Its thickness, which is greatly increased by continued exercise, varies in different regions of the body ; but, in most places, it is about the one sixth part of that of the corion, which it covers. Externally, the epidermis has a rough wrinkled appearance ; it is covered, moreover, with innumerable hairs, and is constantly moistened by the secretion of the sebaceous follicles. The internal surface is slightly mammillated, and so closely united to the subjacent layers that it is impossible to separate it by dissection. It is readily detached, however, by putrefaction ; and when this is done, it is found to present, besides a great many little rounded projections, a considerable number of very delicate, transparent, and colorless filaments, the precise nature of which is still undetermined, though they are probably nothing more than little albuminous processes, which, extending from the cuticle to the dermis, serve to connect them more firmly together. It is the opinion of many anatomists, that the epidermis is porous, and such is no doubt the case. The fact that no openings, save those which give passage to the hairs, have ever been detected, even with the assistance of the most powerful microscope, does not prove that there are none ; for, as has been observed by a distinguished writer, it is possible that they might originally exist, and yet not be visible in the detached cuticle, on ac-

count of their being closed by its elasticity, which, as was before stated, is one of its most strongly marked physical properties. But this is a subject which scarcely concerns the present inquiry, and concerning which it would be unprofitable to speculate.

The epidermis was formerly regarded as being composed of scales, and this opinion has been recently revived by two eminent French anatomists, Breschet and Vauzéme, in an excellent little work on the minute structure of the skin, published at Paris, in 1835. According to these writers, the scales of the cuticle have the general form of an irregular trapezium: they are striated, white, and transparent, of uniform thickness, and placed upon a very thin pellucid membrane, evidently areolar in its structure. They further assert that the epidermis is the product of a peculiar *mucific apparatus*, situated at the bottom of the true skin, and composed of a small reddish gland, with an appropriate excretory duct. The matter secreted by this structure is at first perfectly fluid, but by degrees it becomes hard and dense, until it has acquired all the properties of the membrane under consideration. Dr. Gurtt, of Germany, who has more recently investigated this subject, has not been able to detect the mucific apparatus described by the French authors; and it must be obvious to all, that further researches are wanting before their statements can receive the sanction of the anatomist and physiologist.

Few organs have afforded a wider field for the range of physiological fancy than the epidermis. At one time it has been considered as vital and organized; at another, as destitute of the characteristics of living matter. The latter is still, from some unaccountable cause, the prominent belief of authors and teachers. That the organization of the cuticle is equal to that of the dermis and other similar textures, it would be absurd to presume, as much so as, in my opinion, it would to suppose it wholly destitute of vitality. These circumstances may be stated here as illustrative of the views I wish to inculcate in regard to the present subject. In the first place, we may conclude that the cuticle is organized because the dermis, to which it is intimately attached, does not appear to be irritated by the connection, and makes no effort, consequently, to throw it off. Secondly, because it is continually though slowly undergoing decay and renovation; and, thirdly, because it is liable, as will be hereafter seen, to

a great variety of morbid changes, constituting an important class of cutaneous diseases. Neither vessels nor nerves have been traced into this membrane ; and in the healthy state, it is perfectly insensible. It is highly probable, I think, that its arteries are derived from those which are distributed over the free surface of the corion ; but, owing to their excessive delicacy, they elude our vision, and are incapable of receiving the finest injecting matter.

The second layer of the skin, the most delicate of all, is the *mucous web*, for the discovery of which we are indebted to the celebrated Italian anatomist, Mareillus Malpighi, who first found it in the tongue, and subsequently in the common integument. It forms a thin, soft, semi-fluid lamella, destitute of vessels and nerves, but, like the epidermis, permeable to other bodies. The thickness of the mucous web varies, not only in different regions of the body, but likewise in the different races of mankind. Thus, it is much greater in the neck and scrotum than in any other part, and in the negro than in the European, in whom, from its excessive delicacy and difficulty of demonstration, several anatomists have been induced, though erroneously, to deny its existence. The precise structure of this substance is not known. Though destitute, apparently, of vessels and nerves, it is reasonable to presume that it is slightly organized, its vitality being probably on a par with that of the epidermis, to the inner surface of which it so closely adheres, both before and after it is detached from the corion. A recent French author, Dr. Gaultier, considers the mucous web as being composed of three distinct lamellæ, the external and internal of which are white, whilst the intermediate one contains the coloring matter. This notion, however, is not universally admitted by anatomists.

The mucous web is the seat of the coloring matter of the skin, which is white in the Caucasian, black in the African, yellow in the Mongolian, copper in the American, and tawny in the Malayan. In its essential nature, it is supposed to assimilate itself closely to hematosine, modified by a sort of secretory process. The opinion of Blumenbach and Davy, that it is nothing but carbon, is perfectly unfounded, as is also that of Gall, who considers it as analogous to the gray matter of the brain. This substance, whatever it may be, may be temporarily removed, or perhaps rather blanched, by immersing the skin of the negro in water impregnated with

chlorine: in a few days, the black color returns with all its former intensity.

The fundamental portion of the skin, and consequently the most important layer of the three, both in structure and in function, is the *dermis*, also called the *corion*, or *cutis*. Unlike the cuticle and mucous web, it is a highly organized substance, being most liberally supplied with vessels, nerves, and absorbents, and possessing the most extensive sympathetic connections, — as much so, indeed, as any other organ whatever in the body. After a successful injection, the outer surface of the corion seems to consist of a uniform net-work of minute vessels, which are subdivided to an infinite degree of delicacy, and placed in such close proximity as to render it impossible to introduce the finest needle without drawing blood. The same test proves the equal abundance of nervous filaments, which are derived from the spinal nerves and from the ganglionic portion of the fifth pair of the brain. The sensibility of the skin is well displayed in surgical operations, and in accidental wounds, in which the chief pain is always in the cutaneous textures, particularly in the corion. The absorbents are also extremely numerous; they are very easily injected; and, when this is accomplished successfully, the whole surface of the skin looks like a sheet of silver, their distribution resembling a net-work more than a regular ramification.

The corion, like the other lamellæ, already described, has two surfaces, an inner and an outer; the former of which is of a grayish white color, and hollowed out into innumerable pits, varying in size from the eighth to the twelfth of an inch. Of a rounded, oval, or angular shape, these pits, technically called *areolæ*, are placed close to each other, and are designed to receive granules of the subcutaneous fat, upon the quantity of which depends the sleek or wrinkled state of the skin: they are wanting on the back of the hand and foot. They do not entirely pierce the corion, but terminate each in a sort of cul-de-sac, the bottom of which is perforated by numerous oblique apertures, for the passage of hairs, vessels, nerves, and absorbents.

The outer surface of the corion is of a pale reddish flesh color, being much more vascular, as well as more smooth, than the internal. Numerous furrows, lines, or grooves are to be seen upon it, the size of which varies in different regions: in some situations they are so small as to be scarcely

perceptible, whilst, in others, they are at once large and conspicuous. Specimens of nearly all the lesser varieties are to be found on the back of the hand, where they intersect each other so as to form various angles, from the most obtuse to the most acute. On the bulbs of the fingers, the groves are arranged in concentric semicircles ; in the palm, they are for the most part oblique, a few only being transverse.

Projecting from the external surface of the cutis, yet at the same time embedded in its substance, are the *cutaneous papillæ*, which were first described by Malpighi in 1686, in his work, "De Externos Tactus Organos," and the existence of which has since been generally admitted by anatomists and pathologists throughout the world. They consist of a vast number of minute eminences, covered by the mucous web and epidermis, which thus defend them from the injurious contact of extraneous and hurtful agents. Varying in volume, from the sixth to the twelfth of a line, they are of a conical shape, their base being fixed in the substance of the dermis, the summit terminating in a blunt point. Generally speaking, these bodies bear a pretty close resemblance to the villi of the intestines, excepting that they are smaller, and of a more florid tinge. Like them, they are composed essentially of very delicate ramification of vessels, nerves, and absorbents, connected together by cellular texture. Under ordinary circumstances, the papillæ are relaxed, and on a level with the dermis ; but, when in action, they become erect so as to elevate the superincumbent structures. When the surface is chilled, as happens in the cold stage of intermittent fever, the corion shrinks, whilst the papillæ either continue unchanged, or contract less proportionally, and thus give rise to the appearance described under the name of *goose-skin*. The aggregate of these little bodies, it may now be observed, constitute what is called the papillary texture, which has been regarded by many as a distinct membrane.

The cutaneous papillæ constitute the true organs of touch and sensation, and are therefore most thickly planted where these senses are most acute and fully developed. They are very large and numerous in the palm of the hand and the sole of the foot, especially on the tips of the fingers and toes, where they have a concentric arrangement. In other regions of the body, they are irregularly disseminated ; and, in many parts of the corial surface they are so indistinct that their existence is inferred rather from analogy than from actual

observation. These little bodies are often very conspicuous, as well as exceedingly painful, in inflammation of the skin, arising from the application of a blister, or some other irritating substance.

Besides the little bodies now described, the dermis contains an immense number of *sudorific glands*, so small as to be scarcely perceptible to the naked eye. Their structure is extremely vascular, and their form is that of a distended sac, with a tortuous, spiral canal, which winds its way to the surface of the epidermis, where it opens into a sort of pore. The existence of these glands, although suspected by some of the older anatomists, was first pointed out by MM. Breschet and Vauzème, who are therefore justly entitled to the merit of the discovery. They exist in every part of the skin, but vary in size and form in different situations. In the palm of the hand, and the sole of the foot, Dr. Gurtt describes them as being of a roundish, oval shape, and considerably larger than elsewhere; in the skin of the head, they are more oblong. In the ox, the glands are very small and spherical, and every where uniform in size and shape. The office of these little bodies, it need scarcely be observed, is to secrete the sweat, and to convey it to the free surface of the cuticle.

The dermis, thus constructed, is a dense, firm, and resisting lamella, possessed of a very extraordinary degree of extensibility and elasticity. Considered in reference to its fundamental texture, it is found to be composed of white, grayish-looking filaments, which intersect each other in every conceivable direction, being much more closely woven together on the outer than the inner surface of the membrane. By protracted boiling, the corion may be converted into a viscid, glutinous substance, consisting mainly of gelatine under some peculiar modification. A portion of the skin, however, always remains undissolved; and this, by being subjected to the influence of tannin, is gradually transformed into leather.

It only remains for us, in connection with the present topic, to present a rapid summary of the *sebaceous follicles*. Varying in size, between the smallest pin's head and a millet-seed, the number of these bodies is almost incredible. In a preparation deposited in the museum of the London College of Surgeons, by the late Mr. Chevalier, that gentleman counted not less than one hundred and thirty, on a surface of skin equal to the twenty-fourth part of a square inch. In

their general arrangement and structure, these glands bear a striking resemblance to the follicles of the mucous membranes, being composed each of a small pouch, the interior of which is lined by a process of the cuticle. Fig. 33.*

(Fig. 33.) They are situated, principally, on the outer surface of the dermis, which presents a corresponding number of depressions for their reception; and they all open obliquely on the cuticle by appropriate outlets. (Fig. 34.)

The sebaceous follicles are much more abundant and conspicuous in some regions than in others: they are particularly large and numerous on the nose, forehead, arm-pit, groin, margin of the anus, nipple, mons veneris, and pudendal lips, whilst in many other parts they are scarcely perceptible.

These glands secrete a thin, whitish, oily humor, which is designed to lubricate the cuticle, to render it soft, and to impart to it the suppleness which is necessary for the performance of its functions. It is insoluble in cold water, does not readily burn when exposed to the fire, and appears to be composed principally of ceraceous and oleaginous matter. By being retained too long, the humor becomes concrete, and may be squeezed out of the skin in the form of little, worm-shaped bodies, each having a small, dark point, so as to look like a head.

We have already referred to the remarkable analogy between the structure of the cutaneous and mucous textures, and to the facility with which the one is sometimes converted into the other. Another subject, of still greater importance in a practical point of view, is the sympathetic connection between the skin and other parts of the body. The principal relationships may be thus enumerated: 1. with the mucous lining of the stomach and bowels; 2. with the kidneys; and, 3. with the serous membranes, especially the arachnoid and pleura. Examples, illustrative of the sympathetic connection between the skin and each of these organs, might be adduced

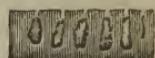


Fig. 33.†



Fig. 34.†

* Sebaceous follicles and their ducts, double the natural size.

† Orifices of the sebaceous follicles on the surface of the skin.

without number; but they would be out of place in a work on pathological anatomy.

The different layers of the skin possess the power of reproduction, after they have been destroyed, but not all in an equal degree. The cuticle appears to be more readily regenerated than any other: it is perpetually in a state of decay and renovation, small furfuraceous scales dropping off in proportion as others form beneath them. In scarlet fever and erysipelas, it often exfoliates in large pieces; yet, under such circumstances, it is generally very speedily reproduced, the new membrane being nearly as perfect as the one that was lost. The dermis and mucous web possess the power of reproduction in a less marked degree. Indeed, many deny that the latter is capable of being regenerated at all, the opinion being founded upon the erroneous statement that the cicatrices of the negro always continue pale. That this is the case occasionally, I am fully aware from my own examinations; but that this is universally or even generally true, is what no one who has investigated the subject will believe. Let any one inspect the skin of a negro who has had smallpox, and he will find that, whilst some of the scars are lighter, others are fully as dark, if, indeed, not more so, than the surrounding skin. So likewise with the scars of wounds and old ulcers, provided there has not been too great a loss of substance. The dermis is perhaps less perfectly regenerated than either of the other lamellæ. We have already seen that it is abnormally thin and delicate, less flexible and elastic, and less capable of withstanding the effects of disease and the varying temperature of the surrounding atmosphere. Capillary vessels exist in great abundance, and are extremely liable to congestion on the slightest exposure; but as to sebaceous follicles, none whatever are to be found. Hence the skin, in such cases, is almost always unnaturally dry, and prone to become fissured. Are the sudorific glands ever reproduced, when destroyed? This is a question which has not been determined by actual observation: conjecture would induce us to conclude that these little bodies shared the same fate as the sebaceous follicles.

I. UNCLASSIFIABLE LESIONS:

Keloides, a disease first described by Alibert, is occasionally observed, though, as yet, I have never seen an instance

of it. Its most common seat is on the neck or shoulder, and front of the chest, where it manifests itself by a small reddish point, about the size and shape of a grain of barley, which goes on increasing until it sometimes attains the diameter of an inch or more. The centre of the tumor is generally somewhat depressed, its surface wrinkled, and its margin radiated, having some resemblance to the claws of a crab, whence its name. To the finger it is hard and resisting, and in its color, it is either of a pale rose, or of a deep cherry-red. On dissection, it exhibits a grayish, fibrous appearance, much like scirrus of the female breast, the rays shooting out in different directions. The progress of this growth is very slow : it rarely ulcerates ; and, in the majority of cases, it is unattended with any particular uneasiness, though at times it is said to cause great pain and throbbing. Occasionally, as has been remarked by Alibert, it disappears, leaving merely a white, firm cicatrix. The most remarkable circumstance about this tumor is its disposition to be reproduced after removal. This may happen repeatedly, until the patient is at length worn out by it.

Melanosis of the skin has been sometimes observed by physicians, either alone, or combined with other morbid products. The most common form in which it occurs is in that of small grains, of the size and color of a black currant. These little tumors, usually buried in the dermoid tissue, are sometimes extremely numerous, giving the cutaneous surface a singularly tuberculated aspect : their occurrence is very rare, and they seldom ulcerate. Deposits of the same substance almost always coexist in the subcutaneous cellular tissue, and in some of the internal organs. In the horse, this disease is of much more frequent occurrence than in man ; and it is also not uncommon in the skin of the ox, hog, and dog, as I know from my own observation.

Encephaloïd has never, I believe, been remarked as a primary disease of the skin, although it frequently extends to it from the subjacent textures, producing a red, spongy, tuberculated sore, more or less painful, and liable to bleed upon the slightest touch. This lesion, which it is unnecessary here more particularly to describe, is most apt to appear in the medullary sarcoma of the breast, testicle, and penis.

Cartilaginous tumors are occasionally seen projecting from the skin, or growing within its substance. Mr. Mayo describes a body of this kind, about the size of a chestnut, which

he removed from the ham, where it had been long in forming. It seemed to have begun in the very centre of the dermis ; was very painful when handled, and possessed all the physical properties of cartilage. Dr. Rayer, of Paris, has described a similar disease under the name of *mollusciform cancer*. In the interesting case reported by this physician, the tumors, situated on the face, trunk, and extremities, were of a deep red color, hard, lenticular, and considerably elevated above the level of the surrounding skin. Frequently these growths possess a real carcinomatous character, exhibiting, when cut into, a grayish, dense, crisp texture, intersected by a great number of fibrous filaments, and yielding a small quantity of lactescent fluid on pressure. In size, they vary between a pea and a pigeon's egg : they are either rounded, conical, or pediculated, and occasionally they rest upon a large flattened base. They often remain stationary for many years ; and, although they are sometimes of a reddish color, they are for the most part of the same complexion as the skin.

A very rare affection of the skin has recently been described by Professor Warren, of Boston, under the appellation of *eiloidés*, from its coil-like disposition.* When first seen, it presents the appearance of a small elevation, similar to that from a burn, which goes on gradually increasing, without pain, heat, redness, or ulceration, until it acquires a great size, and affects the patient's health. In a drawing which has been published by the able surgeon above mentioned, the disease is arranged like a triple coil of inflated intestine, the rolls lying in close contact, and being each four inches long, arising by a narrow base from the right side of the neck. The patient was a negress, fifteen years of age, whose health was otherwise disordered. Soon after its removal, the tumor reappeared in the former situation : it was again extirpated ; and, showing itself a third time, it speedily destroyed the patient. Of the anatomy of *eiloidés* nothing is known. The morbid growth, in all probability, takes its rise in the dermis, but in what particular portion of it has not been ascertained.

Besides these tumors, there is another disease of the skin, also extremely rare, which it will be necessary to notice before we conclude this branch of our subject. I allude to what is called *lepoïdes*, a Greek term, literally signifying bark-like. The most common situation of this disease is the crano-

* *Surgical Observations on Tumors*, p. 48. Boston, 1837.

facial region, generally the forehead, cheek, or temple. Its progress is slow, and old age is its favorite period of attack. Consisting in an inflammation of the dermis, it makes its appearance in the form of a small circumscribed speck, of a dirty color, which becomes covered with a very rough, brownish crust, resembling the bark of a tree. This falling off is soon replaced by another, of the same shape and color. Thus the disease is kept up for many successive years. Ulceration ultimately sets in, and the dermis exhibits a red, glossy surface, spicular, pitted, or granular, which throws out a thin, ill-looking pus. On examining the affected skin, it is found to be almost of a gristly hardness, its internal surface being studded with a number of small, whitish, rounded bodies, connected together by a dense, grayish texture. Very little pain attends this affection, and it often continues for many years before it manifests any malignant tendency.

A not uncommon affection of the skin is *hypertrophy*. Occurring most frequently in old corpulent subjects, it is sometimes congenital, and involves either the whole thickness of an organ, or some one or more of its component layers. The integuments of the nose are particularly liable to enlarge and thicken; and the lesion is also sufficiently common on the neck, breast, the arm, and back, forming rough pendulous folds, several inches in length, which are usually somewhat darker than the skin in the normal state. Hypertrophy constitutes a prominent feature in the Barbadoes leg, in elephantiasis, in burns, and in chronic ulcers of the inferior extremity. The enlargement, in some instances, implicates nearly the whole cutaneous surface, by which the movements of the body are impeded, and the individual acquires a hideous aspect.

A remarkable case of hypertrophy of the several layers of the skin, admirably illustrative of the present subject, is recorded by Andral. The subject was a female, seventy-four years of age, who died of pulmonary phthisis. She had formerly had an ulcer on her right leg, but, for the last thirteen years, the sore had cicatrized, while the limb had gradually acquired a most extraordinary size, being hard and swollen, and the skin rough, and of a yellowish brown, verging here and there upon black. On dissection, the thickened integuments were found to be composed of the following layers: 1. the epidermis; 2. three subcuticular lamellæ; 3. the papillary tissue; 4. the dermis. All these parts, though inti-

mately united, were perfectly separable, indurated, and irregularly thickened. The papillæ were remarkably elongated, turgid, and so crowded together that many of them had lost their characteristic features. Immediately over them, as we have just seen, were three distinct lamellæ differing from each other in their texture, their color, and their consistence. The first, the most superficial, was of a grayish hue, and presented a true horny firmness: this stratum, to which Dr. Dutrochet has applied the appellation of the horny layer, exists only as a rudiment in man, but is very perfectly developed in the inferior animals. The second lamella was of a grayish, brown, or black complexion, reticular in its structure, and composed of exceedingly delicate filaments, crossing each other in every possible direction. This layer, Andral supposes to be analogous to the colored layer in negroes. Lastly, there was a third stratum, placed immediately beneath the preceding, excessively delicate, of a white, undulating appearance, and made up of a cellulo-fibrous substance: it was closely connected with the papillary tissue, and was analogous to the epidemic layer described by Dutrochet. Such is a brief outline of this interesting case, which is so much the more instructive, as it serves not only to illustrate the present lesion, but also the various component lamellæ of the organ in which it is located.

The hypertrophy may be seated principally in the papillæ. The affection is sometimes congenital, sometimes accidental, and is met with in various degrees of intensity. When it accompanies or follows burns, blisters, and chronic eczema, the bodies in question often attain a most extraordinary development; their volume is five or six times above the natural standard; they are of a pale brownish color; and they present an uneven, mammillated appearance, not unlike the pile of coarse plush, which is rendered particularly conspicuous when they are plunged in warm water. The dermis, in these cases, is often very much thickened, as well as indurated, and is covered with thin micaceous scales, which are easily rubbed off, and constantly reproduced.

Hypertrophy of the epidermis is best seen in ichyosis,—a disease which will be particularly described under the head of squamous disorders, amongst which it has been classified by some highly respectable European authors. A corn is a species of hypertrophy of the cuticle, on a small scale, which it will be in place to notice here.

Corns, technically called *tyloses*, are hard, dry, insensible

callosities, occurring mostly on the lateral and dorsal surfaces of the toes, especially the first and last : they are also sometimes seen on the sole of the foot, between the fingers, and on the flexor tendons in the palm of the hand in working people. Their morbid anatomy consists in inflammatory irritation of the cellular layer of the dermis, eventuating in the effusion of lymph, and the consequent thickening and induration of the cuticle. The texture of a corn, especially when old, is of a lamellated nature, and it is almost always more firm at the centre than at the circumference. By cutting away its superficial layers, a sort of internal nucleus is exposed, which has a whitish, horny-looking appearance, and often occupies a considerable portion of the substance of the dermis : it is generally more or less moist, and is now and then surrounded by a minute ecchymosis.

The form of these callosities, although variable, is usually rounded, and their size rarely exceeds that of a five cent piece. Some corns are movable, others fixed ; and cases not unfrequently occur, in which they have a sort of radiating root, extending deeply into the subjacent cellular texture. Their remote cause is pressure, commonly that of a shoe, which, if continued for any length of time, inflames the cutis, and renders it excessively painful. The complaint is more frequent in females than in the other sex, and in the rich than in the laboring poor.

As in some degree connected with the preceding subject, may be mentioned *verruca*, — an affection of the epidermis, characterized by hard, insensible excrescences, denominated *warts*. Of a conical form, their surface is hard, tuberous, fissured, and almost indolent ; in size, they seldom exceed that of a common pea ; in color, they are several shades darker than the surrounding skin ; sometimes they are movable, sometimes fixed. This kind of vegetation is of a radiated structure, being composed of elongated, vascular papillæ, encased in epidermis of variable thickness and density. It is the result, apparently, of a slow chronic irritation, and often occurs in immense numbers on the hand and face of young persons. In the latter situation, warts are apt, in the more advanced periods of life, to take on carcinomatous action, either spontaneously, or from being pulled. In the young, they often disappear of their own accord.

The skin is sometimes the seat of *horn-like excrescences*. These productions occur principally in those parts of the body where sebaceous follicles abound, and hence they are

more frequently observed on the crano-facial region than in any other. In seventy-one cases collected by Dr. Villeneuve, twenty-six were seated on the scalp, five on the nose, two on the cheek, one on the lower-jaw, four on the chest, four on the back, three on the anus and the penis, four on the buttocks, twelve on the thigh, two on the knee, two on the ham, one on the leg, and three on the foot. They have also been seen on the scrotum, the back of the hand, and on the pavilion of the ear. Although the reverse has been asserted, they appear with nearly equal frequency in both sexes, during the period which intervenes between the ages of forty and seventy: in a few instances they have been met with in young children.

The magnitude which some of these excrescences attain is surprising. (Fig. 35.) Bate-man states that there is one in the British Museum, which is eleven inches in length by two and a half in circumference. From three to six inches is by no means an unusual size. Their direction is generally somewhat spiral, twisted, or bent; and, in their appearance, they oft-

Fig. 35.*



* A remarkable horny excrescence growing from the scalp.

en bear the closest resemblance to the horn of the sheep, being marked by rough circular rings with intervening depressions, indicative of the successive steps of their developement. In color, they vary from a dingy yellow to a dark grayish. They are of a firm, cartilaginous consistence, more or less flexible, conical in their shape, being large at their origin, and tapering to their terminal extremity; and, when burned, they exhale a characteristic animal odor. Now and then their surface is imbricated, knobbed, or covered with small pearl-colored scales. Internally they have occasionally a lamellated arrangement, as in Fig. 36.

Fig. 36.*



These excrescences, as was before intimated, are generally connected with the sebaceous follicles, and are directly traceable to chronic inflammation, such as is produced, for example, by a burn, a wound, or a contusion. When first observed, they are quite soft, transparent, and invested by a distinct cyst, which, extending over their base, is gradually and insensibly lost upon their trunk. In the course of a few weeks, they become hard, assume a darker hue, and thus acquire the properties of the horny tissue. Their growth, on the whole, is very slow, from three to five years elapsing before they reach any considerable size. When they drop off spontaneously, as they have been known to do in a few instances, they invariably sprout out anew, pursuing the same course as their predecessors. The same thing happens when they are extirpated without the precaution of destroying the cyst from which they arise. Several such productions, it should be remarked, are occasionally observed in the same individual.

The production of *gangrene* of the external integument is by no means a rare occurrence. It is observed in different situations, and arises from a variety of causes, some of which seem to have a preference, so to speak, for this over other structures. Occasionally, therefore, it may occur as an original idiopathic affection; but more generally it is the result of specific inflammation, or of that depending upon external violence. Of the former, we have an example in malignant pustule, in phlegmonous erysipelas, and in common carbuncle. As illustrating the present subject, we shall describe only one

* A section of the horn, showing its lamellated structure.

of these lesions ; and, as being more interesting than the rest, we shall select malignant pustule, — a disease which, as will be shown presently, seems to owe its origin to the operation of some septic agent.

Malignant pustule, charbon, or anthracion, as it is variously denominated by foreign authors, although very rare in this country, is often observed in certain parts of France, particularly in Lorraine, Burgundy, Provence, and Languedoc. In the low marshy districts of these regions, the cattle are obliged to subsist upon bad and vitiated provender ; and the consequence is, that many of them are seized with dynamic fever, accompanied with gangrene of the skin. In the summer season, indeed, the disease sometimes prevails epidemically. By dissecting animals that perish in this way, or by merely touching their hides or hairs, the disease is readily propagated to the human subject. There are numerous facts, also, which prove that malignant pustule may be communicated by introducing the hand into the rectum, vagina, and throat of cattle affected with this malady ; and similar results are often produced by touching the blood, the secreted fluids, and the excrements, or by injecting the former into the veins.

Shepherds, herdsmen, tanners, and butchers are most subject to the disease ; and the parts most liable to be affected are such as are habitually uncovered, as the face, neck, and chest, together with the arms and hands, the legs and feet.

With regard to the anatomical characters of this disease, with which we are chiefly concerned on the present occasion, they may be divided into three stages, each of which is marked by some peculiarity of feature, worthy of separate consideration.

The time which elapses between the inoculation and the developement of the disease varies from three to eight days. It commences in a small circular prominence, the centre of which soon degenerates into a minute vesicle, about the size of a millet-seed, without heat, tension, or redness. As this vesicle enlarges, it assumes a brownish color, and, when ruptured, discharges a few drops of a yellowish bloody serosity. At intervals, a good deal of itching is experienced, accompanied occasionally with a peculiar stinging sensation. This period lasts from twenty-four to forty-eight hours, and constitutes the first stage of the disease.

The second stage, which rarely endures beyond a few days, is characterized by the developement of a hard, movable,

circumscribed tumor, of a yellowish livid color, with a rough granulated surface. This, in a short time, becomes surrounded by a purple, glossy-looking areola, on which numerous phlyctenæ, containing a reddish serosity, are situated, which quickly run into each other. The disease, having penetrated the entire thickness of the dermis, now invades the subjacent cellular tissue; and the centre of the little tumor presents all the features of an eschar.

In the third stage, the gangrenous point rapidly extends, and the enlarging areola rises above the eschar, causing its centre to be depressed. The surrounding surface is tense, emphysematous, and of an erysipelatous red; the acrid heat and stinging are succeeded by a sense of weight and numbness; the disease burrows deeply into the cellular texture; and the mortified skin is of a blackish color, and of a firm, leather-like consistence. From twenty-four to seventy-two hours is the usual duration of this stage, which is commonly attended with high constitutional excitement. The size of the slough, at this period, varies from six lines to one or two inches.

But it is not always that malignant pustule observes the regularity here ascribed to it. The different stages, as has been observed by a late professor of Paris, to whom we are indebted for a very excellent account of it, often succeed each other in rapid and indistinct succession; and the disease has proved fatal in less than twenty-four hours after its commencement. When it terminates favorably, a red inflammatory circle appears, which serves as a line of demarcation between the dead and the living parts.

From experiments performed by M. Berthèlemetry, a professor in the Veterinary School at Alfort, near Paris, in 1816, it appears that the ichorous matter furnished by malignant pustule retains for a long time its noxious properties. Having put some of the fluid in a corked vial, he preserved it for about eleven months, when he inserted a portion of it into the skin of a stout, healthy horse. The consequence was, a gangrenous tumor, having all the characteristics of malignant pustule, and which, notwithstanding the small quantity of virus, killed the animal in three days.*

In *ordinary gangrene*, or in that variety of it which arises from excessive inflammatory action, the color of the skin changes from a florid red to a darker shade, acquiring, during

* Dictionnaire de Medicine et de Chirurgie Veterinaire, t. iii. p. 713.

the progress of the disease, a purple, livid, or blackish hue. Concurrently with this change of color, the affected part undergoes a decided alteration of structure. It feels soft, boggy, and emphysematous, and the cuticle is raised into numerous phlyctenæ, filled with bloody looking serosity. When completely deprived of vitality, the skin sometimes becomes a shade or two lighter, and is detached, sooner or later, in soft, grayish, inelastic strips, which are often bathed with a thin, ichorous, and offensive fluid. "The ash-colored slough seems to occur most frequently in skin which is moister, and the black-colored, in skin which is more dry than common."

There is a singular species of cutaneous gangrene, to which, from the peculiarity of its appearance, we may apply the term *white*. It generally comes on without appreciable cause or preliminary symptom, occurring in irregular shaped patches, from one to three inches in diameter. The sloughs are of a dead milky color, and of a hard, dryish consistence, yielding little or no moisture on pressure. Any portion of the body may be the seat of this affection; but it would appear, from what has been published on the subject, that the arms, back, and chest, are the parts most frequently implicated. The true nature of the lesion is still involved in mystery.

The *sebaceous follicles* do not seem to be very prone to disease. When inflamed, they augment in volume, their capillaries are greatly injected, and they pour out a preternatural quantity of matter, which, in time, forms an unctuous, tenacious covering, not unlike a layer of semi-concrete wax. If it be allowed to remain, this substance sometimes acquires the appearance of thick, imbricated scales, of a blackish color, which may be mistaken for those of ichthyosis, from which they differ, however, in being much more easily detached. Under this accidental covering, the skin is of an unusually red color, and the mouths of the follicles are either very much enlarged or obstructed, with hard sebaceous matter. This disease, which is almost peculiar to youth and adults, may last for years, and the secretion which attends it is occasionally of a sero-purulent nature, especially in obstinate cases.

Another effect which sometimes results from inflammation of the sebaceous follicles, is the formation of *encysted tumors*, containing meliceric, atheromatous, or steatomatous matter,

or several of these substances conjoined, (Figs. 37 and 38.) The mouth of the follicles being obstructed, and the natural secretion going on, their cavity gradually expands, until the sac acquires, in some instances, the volume of an apple, or even of a cocoanut. The parietes of these tumors are occasionally quite hard and thick, like the dura mater; and cases have been observed, though I believe very rarely, in which they were ossified, or transformed into fibro-cartilage, (Fig. 39.) Externally, they are rough, being connected to the surrounding parts by cellular tissue; whereas, internally, they are generally smooth and glistening. Small sacs are sometimes observed in the interior of these tumors; but these I suppose are rare, and I have never met with them.

In their shape, these tumors are for the most part globular, and they are found more frequently, by far, on the face and scalp than in any other situation. Their number, although usually small, is sometimes very great. In a case which fell under my notice, nine years ago, I counted several hundred on the head and trunk of a man about forty years of age. He informed me that most of them commenced when he was quite young, soon after bathing in cold water, and that he had never experienced the slightest pain from them. The tumors were of the meliceric kind, and the largest were about the volume of a hen's egg, the surface of many being uneven, and here and there incrusted with hard, sebaceous matter, of a darker color.

Tumors of this kind are commonly somewhat movable, though in this respect much depends upon their location.

* A sebaceous follicle in a state of incipient enlargement, its orifice being distended with meliceric matter.

† A sebaceous tumor laid open to show the thickness of its cyst.

‡ Sebaceous tumor, with an ossified cyst.

Fig. 37.*



Fig. 38.†

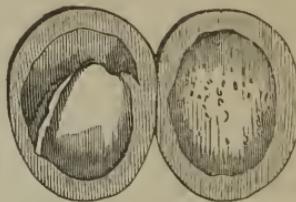
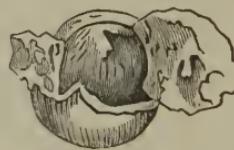


Fig. 39.‡



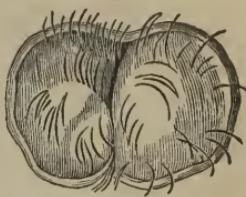
Sir Astley Cooper, who has written an excellent paper on these bodies, considers them in some degree hereditary; but of this I know nothing from my own experience. They are usually unattended with pain, have no malignant disposition; and the skin covering them, although occasionally streaked with large vessels, generally retains its natural character. Sometimes the contents of these tumors are thin and watery, and exceedingly offensive. In other cases, short hairs, very soft, and provided with well-formed roots, have been found in them, (Fig. 40.)

The sebaceous follicles, instead of secreting their accustomed humor, occasionally deposit a hard, *calculous* substance. Meckel relates the case of a young lad, the skin of whose buttocks was completely studded with small concretions of this kind; and similar bodies have been repeatedly found in the sebaceous follicles of the forehead and root of the nose.† Their chemical composition has not been determined, but it is altogether probable that they consist mainly of phosphate and carbonate of lime, agglutinated by a minute quantity of animal matter.

The skin is sometimes the seat of *hemorrhage*. The only form to which I shall allude, is that which constitutes what is called *purpura*. Of this I shall describe only three varieties,—the *petechial*, the *simple*, and the *complicated*, or, as it has been denominated by some, the *hemorrhagic*. These varieties are referable principally to the extent, form, and situation of the effused blood; and it is important to remember that they may all occur simultaneously or successively in the same individual. No period of life is exempt from this disease. In a few instances it has been observed soon after birth.

In the *petechial* species, the blood is collected in minute isolated points, situated immediately beneath the cuticle: they are of a circular shape, from the fourth of a line to a line in diameter, seldom or never elevated above the surrounding surface, and usually of a pale color, though frequently of a deep red or purple. The lesion is generally concomitant of plague, typhus, scurvy, and dysentery, and is almost always

Fig. 40.*



* Cyst of a sebaceous tumor, with hairs in its interior.

† Voiget's Handbuch der Path. Anatomie, Halle, 1804. Erster Band, p. 85.

most conspicuous on the chest, back, and inside of the arms and legs. I have recently seen a case of this kind in a young man, who died of enteritis, attended with profuse bleeding from the nose and bowels.

In *simple* purpura, the parts principally affected are the extremities, especially the inferior. The effusions take place slowly and successively, so that, whilst some are fading and disappearing, others are forming and increasing. They are at first of a vivid red color; but, in a few days, they acquire a deeper and more livid hue; and, in proportion as the blood is removed by absorption, they become greenish, then yellowish, and ultimately vanish altogether. They are also of a circular shape, but much larger than in the petechial variety, being from one to eight lines in diameter, and seated between the cuticle and mucous net-work, or in the dermis and cellular tissue, or in both these situations simultaneously. The duration of the individual blotches is from six to ten days; of the disease, from one to twelve months. Cazenave and Schedel refer to a case in which the effusions succeeded each other at short intervals for more than two years: the patient was a female, forty years of age, who was subject to dysmenorrhœa, and of an unusually plethoric habit.

The essential difference between the preceding and the *complicated* variety of purpura, consists in the effusions in the former being confined to the external surface; whilst, in the latter, they not only occur in this situation, but also in other parts of the body, especially beneath the mucous and serous membranes of some of the principal organs. The blotches are likewise of a deeper color, larger, and less regular in their shape, and in many cases they bear a striking resemblance to the ecchymoses which follow a bruise or contusion. Indeed, the slightest pressure is frequently sufficient to produce them, particularly in parts where the skin is very thin and the cellular tissue abundant. When the effusion is considerable, the cuticle is sometimes elevated into small bladders, which, on breaking, give vent to black, semi-fluid blood. This occurrence, however, is extremely rare, and, in the generality of cases, there is not the slightest elevation. This variety of purpura usually begins on the legs and thighs, from whence it gradually extends over the trunk and arms. The hands and face almost always escape.

Are the above effusions the result of a rupture of the vessels, or are they caused simply by exhalation? Of the two,

the latter supposition is, perhaps, the more correct; at all events, the researches of Fourneaux and others have failed in detecting any communication whatever between them and the neighboring vascular branches. The subject, however, requires further investigation; for the morbid anatomy of this affection, to say the least of it, is extremely imperfect, and does not enable us to offer any satisfactory explanation, either in regard to the nature of its predisposing causes, the character of the primary local lesion, or of its complications.

Besides the varieties now described, there is another form of hemorrhage, in which the blood oozes from certain regions of the cutaneous surface, in the same manner as it sometimes does from the mucous membranes. The discharge is most frequent in hysterical girls, about the age of puberty, and is usually *vicarious*, of some similar natural or morbid state in a remote organ, which is almost always the uterus. The skin appears as if covered with a sort of dew, the blood being effused in minute globules, which, on being wiped away, presently exude afresh. The exhalation, especially when it occurs in females, is commonly periodical, and shows itself simultaneously or successively, at a number of points, as the face, chest, umbilicus, fingers, toes, the palm of the hand, and the sole of the foot.

II. CLASSIFIABLE LESIONS.

1. *Exanthematous Diseases.* The exanthematous diseases are characterized by the occurrence of more or less inflammatory redness in the superficial portion of the dermis, which momentarily disappears under the pressure of the finger, runs its course in from two to six days, and is always preceded and accompanied by constitutional symptoms. The efflorescence is sometimes circumscribed, sometimes diffuse, and occasionally, as in scarlatina, covers the whole body. The usual termination of these affections is by resolution and desquamation. Several of them are of a contagious nature, and occur only once in the same person. The diseases included in this group are roseola, urticaria, erythema, rubeola, scarlatina, and erysipelas.

Roseola is characterized by rounded, circumscribed spots, closely set together, of a deep red color, and from four to six lines in diameter. These patches, which disappear in the course of twenty-four hours, are almost always dependent

upon gastro-intestinal derangement, and are rarely followed by any appreciable desquamation. The disease is not contagious: it is commonly marked by febrile disturbance, and often covers only a part of the body, as the neck, trunk, extremities. It may occur at any period of life, as well as in both sexes, but is most frequent in women and in children. Roseola seems to be seated in the most superficial portion of the dermis, and to consist in a transient injection of the cutaneous capillaries. There is a singular variety of this disease, in which the spots are arranged in the form of rings, the centres of which retain their normal color: two or three such rings, of variable breadth, are sometimes situated the one within the other.

Urticaria, familiarly called "nettle-rash," is a non-contagious inflammation, the duration of which varies from a few days to several months. It appears in the form of prominent wheals, of an irregular shape, paler or redder than the surrounding skin, usually of short continuance, and always attended by a peculiar stinging sensation. In severe cases, the wheals are often very large, hard, and deep-seated, involving the subjacent cellular tissue with a tense, sore, and tumid state of the skin. The favorite situations of the eruption are the shoulders, loins, fore-arms, thighs, and knees. The disease frequently changes its position, appearing at one time here, and at another there; and, as to the individual patches, their duration seldom exceeds twenty-four hours. The anatomical characters of urticaria are still imperfectly understood.

Erythema is an uninfected exanthem, the distinguishing traits of which are superficial blotches, of a deep florid color, lasting from a few days to a fortnight, irregular in their shape, and varying in diameter, from several lines to many inches: the redness momentarily disappears under the pressure of the finger, and is seldom attended with any appreciable swelling. The disease is most common in females, and young, weakly persons; and the neck and chest, together with the superior extremities, are its most frequent situations. Erythema occasionally occurs in regularly circumscribed spots, of a circular shape, and about the size of a split pea: they are slightly prominent, of a bright florid color at the commencement, and subsequently of a violet hue, especially at their centre. This constitutes the *papular* variety of Willan. Another form is the *nodose*, in which the patches, also considerably elevated, are of an oval shape, and from a few lines

to an inch in diameter. In other cases, the redness is annulated, marginate, or diffused over a large extent of surface. In whatever form it may appear the blotches seldom suppurate, nor are they always followed by desquamation of the cuticle.

Rubeola is a contagious epidemic malady, occurring for the most part in young children, during the winter and vernal months. It rarely attacks the same person more than once. The eruption breaks out about the fourth day from the commencement of the indisposition, and is first seen on the forehead, face, and neck, from which it gradually spreads over the rest of the body. It consists of small, red pimples, which are slightly elevated above the surrounding level, and look very much like so many flea-bites. In the progress of the disease, the little speck becomes more prominent: their color is heightened, and their diameter expands, until at length, coalescing with each other, large patches are formed, of an irregular semi-lunar shape, with small intervals of sound skin between them. A minute vesicle occasionally appears at the centre of each spot, filled with a whitish, watery fluid. The swelling of the skin is commonly very trifling, and the redness, which attains its acme in about twenty-four hours after its first appearance, has always a shade of purple. The eruption lasts from three to four days, declining pretty much in the order in which it begun, and is constantly followed by a branny, scurf-like exfoliation of the epidermis.

Rubeola, it would seem, is propagable by inoculation. Dr. Home, of Edinburgh, declares that he has repeatedly succeeded in communicating the disease in this way; and similar results are said to have followed the experiments of Dr. Speranza, of Italy. Dr. Chapman, on the other hand, denies this; asserting, on the authority of numerous trials both with the blood, tears, and naso-bronchial mucus, that he has never been able to impart the affection by this expedient. The question may therefore be considered as still undecided. Meanwhile, no doubt can remain as to its contagious character.

The fifth and last disease that we shall notice under this head is *scarlatina*. Like rubeola, this is a contagious affection, coming on from three to six days after exposure. Attacking children in preference to adults, it often prevails epidemically, especially in winter and in spring, and in one form at least is a source of immense mortality. This form is the malignant, so termed from its being attended with great depression of the powers of life, and from being complicated

with violent inflammation of the palate, tonsils, and pharynx. The efflorescence breaks out from twenty-four to forty-eight hours from the moment of the invasion of the disease, first on the face and neck, then on the trunk, and finally on the extremities. It consists of myriads of small red points, so closely grouped together that the whole surface exhibits a red scarlet hue, and feels rough to the touch, as if fine sand were strewed over it. The color is generally most intense in the evening, and has been compared, not unaptly, to that of a boiled lobster: it reaches its height about the end of the third day, begins to fade on the fifth, and disappears entirely about the seventh. With this efflorescence there is usually violent heat of the skin, with a sense of fulness, and more or less itching; and, in many cases, the whole mouth and tongue, together with the throat, are of a deep, fiery color, evidently from an extension of the disease. Small vesicles sometimes appear on the eruption, resembling those that are occasionally noticed in rubeola, and containing a thin, sero-lymph fluid: they seldom continue longer than four days, and it is not improbable that they are produced by some disorder of the sebaceous follicles. Their number is sometimes immense. In the case of a young girl, twelve years of age, who came under my observation three years ago, the whole body was literally covered with them: they were about the size of a common pin-head, of a whitish color, and filled with a thin, tenacious fluid, which seemed to be gradually absorbed, as none of the little vesicles burst and discharged their contents. The desquamation, which is generally lamellar, begins about the seventh day, and is accompanied by a very disagreeable itching.

The last disease that we shall describe under the present group is *erysipelas*. In the United States, as well as elsewhere, this is an extremely common lesion, and takes place in all ages. I have seen it in new-born infants, in middle life, and in decrepitude. It more particularly occurs in persons of a deteriorated, worn-out constitution, and is usually preceded, as well as accompanied, by symptomatic fever. Although erysipelas may appear on any part of the body, the head, face, and legs are out of all proportion its most frequent situations. Of this disease, there are two important varieties, the simple and the phlegmonous.

The first, which has its seat exclusively in the dermoid tissue, is characterized by diffused redness, with slight

swelling, increased heat, and a tingling, burning sensation. The discoloration is of a deep cherry hue, and disappears momentarily under pressure. When the inflammation runs very high, the cuticle is elevated into vesicles, varying in size from a pin-head to a hazelnut, isolated or conglomerated, and containing a thin, straw-colored, or bloody serosity. The vesications usually appear within the first forty-eight hours, break in a day or two after, and are replaced by thin, hard, yellowish crusts, which subsequently blacken. In milder cases, the disease subsides much sooner: the redness, about the third or fourth day, assumes a dusky yellowish tinge, the swelling diminishes, the skin becomes wrinkled, and the epidermis is detached in small bran-like scales. Few or no vesicles are observed. This variety is sometimes erratic, that is to say, it suddenly disappears at one point, and attacks another, leaving no other traces than a slight desquamation.

In the *phlegmonous* variety, besides the phenomena above described, there is often great swelling of the subcutaneous cellular texture, with infiltration of acrid and bloody serosity, suppuration, or sloughing. This form of the disease I have seen most frequently about the eyelids, and the legs, in old, intemperate subjects. Great constitutional disturbance usually attends: the affected part is exceedingly painful, and the dermoid and cellular tissues often slough in large patches, the latter coming away in dark-colored, dirty-looking shreds.

2. *Pustular Diseases.* Pustules are produced by inflammation of the dermoid textures, terminating in an effusion of matter, which elevates the cuticle into small, circumscribed tumors. The genera comprehended in this order are acne, sycosis, ecthyma, porrigo, impetigo, vaccinia, and variola. Some of these affections are acute, and others chronic; some are contagious, and others not; some are discrete, and others confluent. Differing as they do in these particulars, they all resemble each other in the fact of their terminating in a scabby incrustation, varying in thickness and density in different cases, and leaving, on dropping off, the surface to which it adhered, for some time, of a red color.

Acne is a chronic inflammation of the sebaceous follicles, lasting from several weeks to as many years, characterized by the presence of small, isolated pustules, the most common seat of which is the upper and back part of the trunk, though they are often seen also on the forehead, nose, chin, and temples. The limbs are seldom affected with them. The dis-

ease is equally frequent in both sexes, and is particularly apt to occur about the age of puberty. The skin of the affected region looks dense and unctuous, the follicles are enlarged, their parietes are engorged with blood, and their orifices are marked by black points, giving the disorder its characteristic aspect. Each pustule is encompassed by a red areola; matter gradually forms in its interior, mingled with the natural secretion; and, after a short time, a thin scab appears, which, on falling off, exposes a florid and slightly elevated prominence, that gradually sinks to the level of the surrounding surface. Small scars sometimes remain; and, in old chronic cases, the skin is often quite hard, and exhibits a rough, granulated appearance, with varicose enlargement of its vessels.

Seated in the sebaceous follicles, and closely allied to the disease just described, is *sycosis*, the mentagra of Willan and Alibert. Its distinguishing feature is the successive evolution of numerous sharp-pointed pustules, scattered over the hairy scalp, upper-lip, the chin, lower-jaw, and side of the face, occurring usually in adults, and preceded by considerable redness of the affected part, with a sense of heat and tension. Red vesicles soon become visible, which, by the third day, assume a pustular form, standing out like circumscribed elevations, the summits of which grow white, and are gradually filled with pale yellowish matter. The prominences subsequently increase a little in size, and, when fully developed, are as big as a millet-seed. Between the sixth and seventh day, each pustule bursts, its sides shrink, and a slight discharge takes place, which dries into a brownish crust, that is feebly adherent to the skin, and insensibly lost in the adjacent epidermis.*

When the pustules are very numerous, they sometimes coalesce, and the inflammation is then apt to extend to the subjacent cellular texture, which is rendered hard and painful, and exhibits all the appearances of a true phlegmonous swelling. The pustules themselves are quite large: they rest upon a red, tuberculated base, often contain bloody matter, and are covered with thick, dirty-looking incrustations. The skin is sometimes very much altered, and sprouts out in the form of moist, vegetating excrescences. Arrived at this pitch,

* Rayer's Treatise on Diseases of the Skin, p. 481. Second edition. London, 1835.

the disease is extremely intractable, and presents a most loathsome aspect: the hair falls out, and the part is constantly bathed with a thin, sero-sanguinolent fluid, often excessively acrid in its character. Fortunately, this affection is very rare in this country, and seldom attains the height it does in continental Europe.

The disease next in order is *ecthyma*, which, as has been already stated, is closely allied to *rupia*, being, indeed, considered by some merely as a variety of it. It is an inflammatory affection of the dermoid texture, non-contagious, and characterized, at its height, by *large*, rounded pustules, usually distinct from each other, and resting upon a hard, florid base. All parts of the body are liable to be affected; but the regions most frequently involved are the neck, chest, and shoulders. The eruption generally begins by small, reddish elevations, which rapidly augment in size, and become filled, in the course of a few days, with sero-purulent matter, the base, in the mean time, extending in diameter, and exhibiting a bright scarlet hue. In this state, the larger and more mature pustules have a conoidal shape, are hard and painful on pressure, and bear a close resemblance to small boils, their size being between that of a lentil and a big pea. A pseudo-membranous substance is also frequently to be distinguished in their interior, particularly towards their centre.

In from three to five days, the contents of the pustules escape, and concrete into thick, whitish, adherent scabs, the disengagement of which, occurring at indefinite intervals, leaves the part of a red, livid color, each spot being from four to eight lines in diameter, and marked at its centre by a minute, superficial cicatrix. Acute *ecthyma* is often accompanied by severe lancinating pains, and has only one crop of pustules; whereas the chronic form of the disease, which is by far the most common, has always a continued succession of them. Some of the pustules occasionally terminate in ulceration, producing ill-conditioned, painful sores, attended with a sanguous, bloody discharge, and followed by thick, dark-colored crusts.

Impetigo is a non-contagious, chronic disease, which is exceedingly prevalent in this country, in young children during the period of dentition, especially in such as are of a scrofulous habit. It is most frequently observed on the face and legs, and next in order on the forehead, neck, and trunk. In some instances—and these are not infrequent—the dis-

ease covers all these parts simultaneously, or gradually travels, as it were, from the one to the other. The pustules are *small*, irregularly circumscribed, with only a slight elevation of the cuticle, and terminate in thick, rough scabs. The disease is accompanied and produced by inflammation of the part affected, which continues for an indefinite period, and causes considerable enlargement of the capillary vessels, particularly of the veins. At first, the eruption is vesicular; but, like that of small-pox, and other kindred disorders, it becomes pustular, the elevations being distended, in a few days, with sero-purulent matter, which is often poured out in great abundance, and rapidly hardens into thick, semi-transparent, friable scabs, resembling fragments of dried honey. Occasionally, the incrustations, instead of being of a clear yellowish color, are of a light greenish brown, or mahogany hue. The scabs having fallen off, the denuded skin is observed to be of a deep red complexion, slightly fissured, abnormally thick, tender on pressure, and to exude a considerable quantity of sero-purulent matter.

Impetigo appears under two principal varieties of forms,—the small pustules that characterize it being, in the one, irregularly disseminated, with healthy or more or less inflamed intervals,—in the other, disposed in groups, generally of an oval shape, and resting on a tumid, rose-colored base. Each of these varieties is acute or chronic, according as there is only a single crop of pustules, or a successive reproduction. Closely as this disease resembles ecthyma in many of its features, it can always be easily distinguished from it by the *smaller* size of its pustules, their mode of developement, and the *lighter* color of their base.

The term *porrigo* is applied to a chronic inflammation of the skin, essentially contagious in its nature, and characterized principally by the appearance of its scabs, which are of a bright yellow color, very dry, thoroughly adherent, and of a circular shape, with a central, cup-like depression, and thick, prominent, and inverted edges. The most usual seat of the disease is the scalp, from whence, however, it often extends to the forehead, temples, chin, eyelids, and other regions, until, in some instances, it covers almost the entire body. Occurring indifferently in both sexes, at all seasons of the year, and at all periods of life, it is most common in infancy and childhood, and is always of indefinite duration, lasting at one time only a few weeks, at another a number of

months, and, in a third series of cases, perhaps several years. Alibert describes five varieties of porrigo, Willan not less than six. These divisions are certainly uncalled for, as they differ from each other merely in the intensity of the diseased action, its location, and the distribution of the pustules. The mildest form of the eruption, and one which is extremely common in this country, affects the head and face of infants, and is usually known by the name of *crusta lactea*.

Porrigo, in whatever form it may appear, or wherever situated, always commences in very small pustules, scarcely rising above the surrounding surface, and covered, from the very first, with a thin yellowish crust, with a minute central pit. Examined at this period, the pustules are found to contain a drop of sero-purulent matter, which, instead of escaping, as happens in most other kindred diseases, always remains, and dries in their interior. The scab, manifesting itself, as we have just seen, almost simultaneously with the eruption, goes on increasing until it reaches the diameter of a ten cent piece: its central depression in the mean time becomes remarkably distinct; and, in the course of a week or so, it acquires all the characters above assigned to it. When the pustules are confluent, the incrustations often cohere, and are detached in large yellowish masses, leaving the cuticle tender, red, elevated, and marked with deep lines. Excessive itching generally attends this disease, and the scabs are often reproduced in great numbers and with astonishing rapidity.

The odor of the scabs is peculiar. Alibert and Rayer state that it resembles that of the urine of the cat. When the scabs are softened with emollient poultices, the smell changes, becoming faint and sickening, and a good deal like that which is caused by boiling bones with their ligaments. The substance of which they are composed has been carefully analyzed by Thenard, who found that one hundred parts contain seventy of coagulated albumen, seventeen of gelatine, five of phosphate of lime, and eight of water.

Porrigo is supposed by some to be seated in the piliferous follicles,—an opinion which seems so much the more plausible, when it is remembered that the disease principally occurs in those regions which abound in these structures, and that a hair frequently occupies the centre of each pustule. However this may be, the hairs are always considerably affected: they become dry, stinted in their growth, and many of them fall off. This is particularly apt to take place in chronic

porigo of the scalp, the *furfuraceous variety* of Bateman, which is almost always attended with permanent baldness. Occasionally, the piliferous follicles remaining, a new crop of hairs is produced, which are thin, white, and downy.

Vaccinia, usually called cow-pox, is a contagious disease, which is transmitted by inoculation from one individual to another, and which is characterized by the development of large, multilocular, pearl-colored pustules, surrounded by an erythematous areola, and followed by a brownish scab, which falls off about the twenty-fifth day, leaving a pitted scar. Three well-marked stages are to be observed in the progress of this affection.

The first stage commences on the fourth day after the insertion of the virus, and terminates on the ninth. At this time the true vaccine inflammation first manifests itself, and the puncture, which until now resembled a mere scratch, assumes a pale rose-color: it is somewhat conical in its shape, rises a little above the surrounding surface, and presents the appearance of a flea-bite. By the fifth day, the point has augmented considerably in volume: it is of an umbilical form, with a slight central depression, and its cuticular covering is elevated by a minute quantity of transparent fluid into a firm and resisting pustule. On the sixth day, all these characters are more distinct, and the affected part stands out in bold relief. The vaccine tumor is increased in all its dimensions, and its inflamed surface has a more transparent and polished aspect. The pustule, which until now was quite small, occupies a circle of about a line in diameter; its surface has a radiated, argentine appearance; its edges are smooth and rounded; and its centre is not only more depressed, but it is hard, dry, and of a darkish color. From this time on, the pustule gradually augments in size, the margin becomes more prominent, and the centre exhibits a concave cup-like form.

During the second stage, that is to say, from the ninth to the eleventh day, the pustule attains its most perfect development, about four lines in diameter, and projecting from one to two lines above the surrounding level. It is encircled by a vivid red areola, often several inches in extent; its margin becomes more full, and the central depression is either partially or wholly effaced. The erythematous surface around is the seat of a great number of minute vesicles, and there is marked swelling of the subjacent cellular tissue, extending generally to the axillary ganglions, and rendering the limb

stiff and painful. The virus, which is now ripe for use, is still limpid; and, if the pustule be punctured, it will ooze out, drop by drop, until the little cells containing it are emptied. These cells, as has been ascertained by dissection, are extremely small, as well as numerous, and perfectly distinct from each other, none of them communicating together. Gendrin states that they are arranged in two concentric rows; and that the centre of each pustule is occupied by a minute quantity of yellow muddy pus, contained in a sort of funnel-shaped receptacle just beneath the cup-like depression of the epidermis.

On the eleventh day, the commencement of the third stage, the desiccating process sets in. The central depression assumes the appearance of a light brownish crust, the contained virus acquires a muddy serous color and a viscid ropy consistence, the areola gradually fades, the swelling decreases, and the epidermis falls off in small furfuraceous scales. By the fourteenth day, the pustule is greatly diminished in size, the scab is of a horny hardness and of a yellowish complexion, and the areola is reduced to a narrow purple circle not more than the eighth of an inch in diameter. From this period, the swelling and tension of the arm rapidly subside, the vaccine crust augments in density and depth of color, and is detached about the twenty-fifth day, counting from the insertion of the virus. The scar thus disclosed, is slightly depressed, of a circular shape, from three to five lines in diameter, and of a pale reddish hue, exhibiting a number of small honey-combed pits, indicative of the number of cells of the vaccine pustule. The cicatrix becomes ultimately whiter than the surrounding skin, and the pits remain indelible.

The fallen scab is of a brownish mahogany color, hard, dry, brittle, of a circular shape, and more solid, as well as thicker and more opaque, in the centre than at the circumference. Its upper surface is smooth, convex, and somewhat polished; the other, on the contrary, is rough, flattened, or slightly concave. Albumen is its chief ingredient. When recent, it can be cut into thin, grayish slices, which expand by maceration, turn white, and exhale a sickening animal odor. Drying hardens it very much; and trituration with water converts it into a ropy cream-like mixture, which is capable of communicating the disease. The induration of the scab is much influenced by the atmosphere. If the air

is excluded, the secreted matter is said to be thrown off in small, soft pieces, without the formation, frequently, even of a scar.

Variola is an acute, cutaneous inflammation, consisting of numerous umbilical pustules, preceded and accompanied by fever. It is contagious, occurring generally only once in the same person, and running its course in about twenty-eight days. When the pustules are situated at some distance from each other, the disease is said to be distinct, and confluent when they are agglomerated. It is also divided into natural and inoculated, according as it arises spontaneously, or from the introduction of the small-pox virus. The period which intervenes between the infection and the developement of the disease varies from six to twenty days. The pustules not only cover the skin, but frequently also the mucous surfaces that are directly continuous with it, as the eyes, mouth, and pudendal lips.

The eruption, which is sometimes preceded by a general erythematous blush, usually takes place from forty-eight to eighty hours after the commencement of the indisposition, appearing first on the face and neck, then on the chest, abdomen, arms and legs, and lastly on the hands and feet. This order of invasion, however, is not constant; for it not unfrequently happens that the disease first manifests itself on the trunk, and even on the extremities, before it invades the head, although it is on the latter region that it is always most violent. The eruption begins in small, red, circular points, having very much the aspect of flea-bites, and which, although widely dispersed originally, rapidly multiply, and, in the course of a few days, complete their number,—the cutaneous surface being, in the mean time, hot, tumid, and shining. During the period which intervenes between the efflorescence and the suppuration, embracing nearly one week, the elevations gradually increase, project above the level of the surrounding parts, and assume the appearance of distinct pustules, each of which exhibits a well-marked central depression. As early as the second day, these elevations are already bounded by a regularly formed ring of inflammation: their form is umbilical, and their summit contains a drop of limpid fluid. In this manner, the developement proceeds until suppuration commences, which it usually does about the sixth day. During this period, constituting what is termed the eruptive stage, the pustules have a cellular

structure, being composed of little compartments, separated by thin partitions which converge to a central point.

The suppurative process having commenced, the pustules lose their umbilical shape and become hemi-spherical ; their surface acquires a rough, whitish aspect ; and their contents continue to grow more and more opaque, being at first of a milky hue, and afterwards of a pale straw-color, with various degrees of turbidity. A small circular speck now generally appears in the centre of each elevation, which gradually extends towards the circumference, until at length the whole superficies assumes the same purulent look. Whilst these changes are taking place externally, the internal cellular structure gives way, the little compartments are broken up, and the matter occupies a single cyst, with dense, resisting parietes. With proper care, this cyst can be readily lifted out of its situation : it is of a rounded shape, from two to four lines in diameter, and is deeply lodged in the dermis, projecting a considerable distance into its substance. The suppurative process usually begins on the forehead and face, and ends on the hands and feet, where the pustules also remain much longer before they break, owing, no doubt, to the great thickness of the cuticle. The intervals between the pustules, during this stage, are generally tumid, from the infiltration of sero-albuminous matter, and of a florid red, the inflammation being of a phlegmonous character ; and the patient experiences a sensation of tension and soreness, occasionally amounting to real pain.

About the tenth day, the pustules have arrived at their full height ; they are filled with thick, yellowish pus, and they present the appearance of so many little abscesses. The desiccating process always begins on the face, and gradually extends to the other regions of the body, occurring last on the feet and hands. It is usually accompanied with violent itching, and with a peculiar nauseous odor, not unlike that exhaled by the rattlesnake. The scabs, which fall off from the tenth to the fifteenth day after the appearance of the eruption, are of a brownish color, lamellated, dry, and of a horny consistence. The scars which are left by their detachment, and which are commonly confined to the cranio-facial region, are depressed at their middle, and traversed by small, narrow ridges, which often greatly disfigure the features, especially in the confluent variety. In regard to the form,

the utmost irregularity prevails, some of them being circular, some oval, others angular. Their depth is usually considerable, presenting an appearance as if they occupied a goodly portion of the thickness of the dermis. These scars are at first red, but soon change to a dark purple color, which they retain for many weeks; by degrees, however, they grow whiter and whiter, but they always remain more pale and opaque than the rest of the skin.

The skin of variolous subjects always putrifies much more promptly than the cutaneous tissue in the sound state. By artificial injection, all the capillaries can be so completely distended as to give the affected part a red scarlet hue; but it is a singular fact, that none of the matter ever finds its way into the pustules, or even into the dermoid substance immediately around them,—owing to the circumstance, as is supposed by Gendrin, that all the vessels in this situation are either obliterated or wholly destroyed, the tissue itself being of a deep, uniform color, and infiltrated with blackish blood. If mercury be used, a portion of it is generally effused both around and within the pustules; yet none of it appears to penetrate into the vessels of these parts.

As connected with the disease just described, is *varicella*, concerning which it will be necessary here to say a few words. Like small-pox, this disease is contagious, and usually occurs only once in the same individual, attacking children in preference to adults. Preceded by slight fever, and other symptoms of derangement, the eruption generally commences on the body, though sometimes on the face and limbs, and gradually rises into small, red, circular points, which, in turn, are replaced by lenticular, globular, or conical pustules, somewhat analogous to those of variola. The pustules are sometimes discrete, sometimes collected together: they are surrounded by a red, rose-colored areola, contain a transparent serous fluid, which in time assumes a thick milky appearance, are soft and flaccid to the touch, and generally terminate from the fifth to the ninth day, with a thin, brownish, furfuraceous desquamation, which rarely leaves any cicatrix. The eruptive stage of varicella, is rarely completed under two or three days, and hence the disease is often prolonged to a fortnight, the parts on which it first broke out being covered with scabs, when the pustules in other regions have scarcely arrived at maturity.

3. Papular Diseases. The lesions arranged in this order are characterized by hard, solid elevations, usually of the color of the skin, to which they impart a rough, uneven sensation, preceded and accompanied by pruritus, and terminating by resolution, desquamation, or slight ulceration. Their progress is commonly slow; and there is no part of the cutaneous surface which is not liable to be attacked by them. The diseases belonging to this division are only two,—lichen and prurigo.

Lichen is a non-contagious disease, which may appear on any part of the body, though in most cases it manifests a decided preference for the neck, face, hands, and fore-arms. It is distinguished by hard, firm papulæ, generally of a white color, sometimes red, almost always clustered together, and accompanied with considerable itching, which is augmented by the heat of the bed, and liable to well-marked exacerbations. The elevations are seldom larger than millet-seeds; and, although commonly aggregated into irregular groups, yet occasionally they are united into circular patches, or into long, narrow strips, stretched spirally around the affected part. The accompanying redness, if there be any, disappears about the end of the fourth day, though sometimes not until much later, and is followed by a slight furfuraceous desquamation, which may continue for several weeks, or even months. In violent cases, the papillæ occasionally ulcerate, and discharge a thin, sero-purulent fluid, which gradually concretes into small, soft, yellow scabs, somewhat rough, and easily removable. At other times, again, the elevations become confluent, and are surrounded each by a small, reddish border.

In chronic lichen, the skin is harsh, dry, and sometimes considerably thickened. Deep fissures are also frequently observed, especially about the joints, and the cutaneous functions seem to be almost entirely suspended.

Prurigo, in its essential characters, resembles lichen, but differs from it in the greater size of its papulæ, the excessive itching, and the want of discoloration of the skin. It is always chronic, its duration varying from one to many months; and its most usual seats in the neck, shoulders, and pudendal lips, where the desire to relieve the pruritus by scratching is frequently irresistible. Ordinarily, the papulæ are very numerous, especially in young persons, and it is by no means uncommon to observe several successive crops of

them,—new ones appearing as fast as the old ones heal. From the intolerable itching which attends them, they are apt to become torn by the nails, and replaced by small, blackish, circular scabs.

4. *Bullar Diseases.* The bullar diseases which are, properly speaking, only two in number, are marked by the formation of small bladders, of a circular figure, varying in size from that of a pea to that of a goose's egg, generally transparent, and filled with a serous, lymphy, or sero-purulent fluid, which is poured out between the dermis and cuticle. These small bladders attain their height in the course of seventy-two hours, when they commonly burst, and are succeeded by scabs, sometimes of considerable thickness. Their progress is generally chronic, and their duration varies from one or two weeks to several months.

Pemphigus is characterized by the formation of large bullæ, generally of a pale straw-color, isolated, and occurring simultaneously on several parts of the body. In regard to its symptoms and duration, pemphigus may be divided into two distinct varieties, the acute and chronic. This division is contrary to the classification of Willan and Bateman, who admit only the latter form of the disease, under the denomination of *pompholix*. The disease is particularly apt to occur in adults and old persons, and is said to be more common in males than in females; but of this I know nothing from my own experience.

In the *acute variety* of this disease, there are generally well-marked constitutional symptoms, which, in the course of two or three days, are followed by the eruption of small, red, circular spots, which, rapidly increasing in size, soon turn to a more dusky hue. They are then transformed into bullæ, varying from the magnitude of a pea to that of a large hazelnut, of a rounded shape, and encircled generally by a vividly red border, from one to several lines in width. Their number is variable, from a single one to many: they increase in size during the first twenty-four hours, and the contained fluid, which is at first thin and limpid, becomes yellowish, turbid, and even reddish. They reach their acme by the end of the third day, when they shrivel and dry up; or they burst, and leave small, thin brownish crusts. The spots exposed by these crusts are of a dull red color, of an irregular form, isolated, and liable, from time to time, to slight exfoliations.

The duration of each bulla is about one week, and not unfrequently there are several successive crops of them on different parts of the body, so that the disease may be protracted for two or three weeks.

Chronic pemphigus differs from the acute principally in the greater tardiness of its progress, by the absence generally of the red areola, and in the peculiar mildness of the antecedent and accompanying constitutional manifestations. The bullæ, also, are generally somewhat larger ; and, in some rare cases, they cover the whole surface of the body, though they are for the most part confined to particular regions. In three or four days from their first developement, they usually break, pouring out a thin yellowish or reddish fluid, so acrid, in some instances, as to irritate the surrounding parts. The sores thus exposed present a red, inflamed aspect ; and, as the epidermis dries over them and exfoliates, new bullæ spring up in their neighborhood, and follow the same course. In this way the disease may last for several months or even years. Old people are most liable to it, especially those whose constitution is exhausted by debauch and intemperance.

Rupia presents several varieties ; but, as has been justly observed by Cazenave and Schedel, they differ from each other merely in their extent and intensity ; and hence, for pathological purposes, it will be as well to consider them under one common head. The affection, which is very analogous to *ecthyma*, usually occurs in a chronic form, its course being seldom run under several months. It is characterized by small, isolated, flattened bullæ, about the size of a shilling, with or without redness of the skin, and filled with a serous fluid, which soon becomes opaque, puriform, or sanguinolent ; and to which succeed thick, rough, dark-colored crusts, somewhat thinner at the circumference than at the centre. Ulcerations, either superficial or deep, generally exist under these scabs, which fall off in the course of a few days, and are speedily succeeded by cicatrization. Such, however, is not always the progress of this disease. In some instances, the sores remain open for a considerable period, forming scales which are removed as fast as they desquamate. Occasionally the disease disappears without the developement of scabs ; but this, I presume, is a very unusual occurrence.

Rupia sometimes terminates in gangrene. This is par-

ticularly apt to take place on the thigh, breast, abdomen, and scrotum of young, cachectic children. The bullæ in such cases are generally preceded by small livid spots, and they often form with great rapidity, their contents being somewhat acrid and of a blackish color. In a short time, the bladders give way, exposing extensive ulcerations, bathed with a bloody, ill-conditioned sanies, and encircled by livid and painful edges. Great constitutional disturbance usually attends this variety of rupia, and not unfrequently it terminates in death. Cicatrization is always slow, and oftentimes the body is disfigured with ugly scars.

Eczema is an inflammation of the skin, non-contagious, and partially liable to occur on the scalp, ears, breast, scrotum, arm-pit, groin, and pubes. Though usually limited to one or two spots, it sometimes occupies the whole surface of the body, and may be either acute or chronic. Biett states that the disease is more frequent in warm than in cold weather, and in women than in men. Arising occasionally without any assignable cause, it is often induced by sudden vicissitudes of temperature, exposure to the hot rays of the sun, dry friction, and by the internal or external use of mercury.

Eczema is characterized, at its commencement, by an evolution of very minute vesicles, closely crowded together, transparent, silvery, and reposing upon a surface which is either of the natural color, or else more or less red and inflamed. After having continued for some time, the disease either becomes chronic, or it terminates in the absorption of the fluid, or in superficial ulceration, followed by furfuraceous desquamation. Much itching and smarting often accompany this disease, and hence it is frequently mistaken for scabies. From this affection, however, it may be easily distinguished by its non-contagiousness, and by the agglomeration and peculiar shining aspect of its vesicles.

In violent cases of eczema, the vesicles become confluent, and are liable to break, giving vent to a thin, sero-purulent fluid, which gradually concretes into soft, yellowish scales, often of considerable size and thickness. These are frequently denuded, leaving always, on being detached, a crimson surface, from which exudes a reddish serosity, which follows the same course until the inflammation subsides, — the scabs becoming every time thinner and lighter, and the sore less red and sensitive. Cases of this kind frequently last for several

weeks, some of the vesicles drying as others appear ; and they are usually preceded, as well as accompanied, by strongly marked constitutional symptoms.

When the disease runs into the chronic form, the skin being perpetually irritated by the evolution of new vesicles, and the constant discharge of ichorous matter, continues deeply inflamed, at the same time that it is very apt to become chafed and excoriated, especially about the joints. The eruption, in such cases, sometimes persists for months, the secretion, in the mean while, going on in full vigor ; at other times, however, the discharge is either very slight, or the part is entirely dry, and covered with thin, soft, yellowish scabs, which, on falling off, expose a cracked and slightly inflamed surface.

Miliaria is an eruptive disease, generally, though not always, symptomatic of other affections, attended with profuse perspiration, and a feeling of heat and itching. Every portion of the body is liable to it, but the regions most frequently affected are the neck, breasts, and back, with the inside of the thighs. Its duration is from one to three days. The vesicles, which are at first very small and transparent, are rarely confluent ; but they often occur in irregular groups or patches, the surface over which they are scattered being either reddened, or of the natural color. When fully developed, as they generally are in the course of thirty-six or forty-eight hours, they are of a rounded form, pearly in their appearance, filled with a milky fluid, and about the size of millet-seeds. The eruption sometimes covers the greater part of the body, but usually it is widely scattered, and confined to particular regions. From eczema this disease may be distinguished by the rapidity of its progress, the shortness of its duration, and by the larger size and greater distinctness of its vesicles.

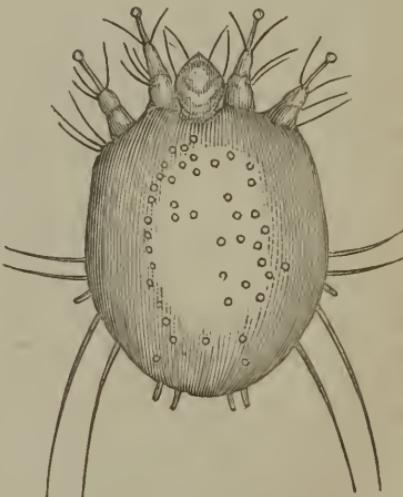
5. *Vesicular Diseases.* This class of cutaneous diseases is characterized by the evolution of small vesicles, acuminate or globular, distinct or confluent, and occurring generally in irregularly circumscribed spots, the surface on which they appear being either of the natural color, or marked by inflammatory redness. The contents of the vesicles are at first thin and transparent, afterwards milky and opaque, and, in some instances, even slightly purulent. The eruptions arranged under this group may occur in any part of the body, are seldom serious, and may ter-

minate either by resolution, desquamation, superficial excoriation, and in the formation of soft yellowish scabs. Their duration varies from a few days to several weeks, or even months.

Scabies is an inflammatory affection, contagious, accompanied by an insect, and characterized by pointed vesicles, transparent at the summit, of a light rosy tint, and filled with a thin, viscid fluid. By scratching, these vesicles are easily broken, when their contents escape, and expose a corresponding number of small, red, inflamed specks, which frequently run into each other. The eruption is sometimes very trifling, but in many cases it is very extensive, covering a large portion of the cutaneous surface. It never, however, appears on the face; and, what is singular, it is always most abundant at the flexures of the joints and between the fingers, owing, doubtless, to the great delicacy of the skin in these situations. In infants, the disease is usually developed in four or five days after exposure to the contagion; in adults, in from one to two weeks. A slight itching is first felt in the parts, which is invariably increased by the warmth of the bed, by sitting near the fire, or by stimulating food and drink, and, in plethoric habits, is sometimes almost intolerable. No fever attends this affection.

It has been already stated that this disease is accompanied by an insect. Whether this is a constant occurrence is not fully determined, but that it is occasionally observed is established beyond contradiction by the recent researches of Dr. Renucci, of Paris. The insect, the existence of which was long ago suspected, if not actually demonstrated, by some of the older physicians, is called the *acarus*, or *itch-ciron*, and is seldom to be found in the vesicle, but almost always in a small epidermic canal, which leads from it, and which is either

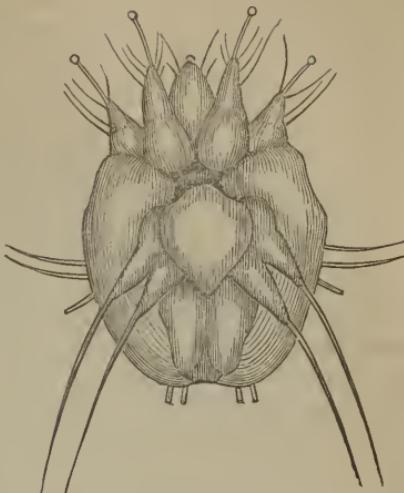
Fig. 41.



straight or tortuous, and several lines in length. The acarus (Figs. 41 and 42) is of a white, opaque color, and about the size of the sharp extremity of the finest needle, presenting, when seen through the microscope, the form of a tortoise. It has eight small feet, and the head is a perfect retracting sucker: the belly presents several dark-colored spots, and on the back are to be seen a number of eccentric lines, placed at short intervals, and having the appearance of joints.*

Willan and Bateman have subdivided *herpes* into six species, — a circumstance which, considering that they all occur pretty much under the same states of the constitution, and require the same kind of treatment, may be considered as a sort of "hair-splitting," certainly as unnecessary in pathology as it is injurious. The disease is characterized by distinct but irregular clusters of vesicles, which are set in close proximity, upon a vividly red base, surrounded by intervals of sound skin. The spots thus formed vary in size from that of a guinea to that of the palm of the hand, and the vesicles from the smallest pin-head to that of a pea. The lymph of the vesicles, which is at first clear and colorless, becomes gradually milky and opaque, and ultimately concretes into thin brownish scabs, which fall off about the tenth day from the time of their eruption. Sometimes tedious ulcerations ensue, leaving strongly-marked cicatrices; and now and then the disease disappears by desquamation, the fluid being absorbed by the end of the first week. In the **zonoid** variety, vulgarly called "shingles," the vesicles are aggregated into irregular oblique patches, in the form of a half belt. According to Cazenave, the patches generally begin at the centre of the body, from whence they extend in

Fig. 42.



* See American Journal of the Medical Sciences for February, 1835, in which is a full account of this insect, with two excellent figures.

an opposite direction, without ever passing the median line. Ring-worm is another variety of herpes, the characters of which are so distinct as to render any particular account of it unnecessary.

Herpes lasts from one to several weeks, passing through a regular course of increase, maturation, and decline. It is generally very mild in its character, may be seated on any part of the body, and often coexists with other affections, either cutaneous or internal.

6. *Tubercular Diseases.* The diseases arranged under this head are characterized by the developement of small, solid, circumscribed tubercles, of a rounded or conical shape, of a reddish or purple color, generally isolated, and confined to particular regions. After having continued for some time, varying from a few months to several years, they either disappear, or terminate in ill-conditioned ulcers. The affections which properly belong to this division of our subject, and which are seldom seen except in tropical countries, are Greek elephantiasis, framboësia, and lupus.

Greek elephantiasis is a chronic affection, characterized by soft, prominent tubercles, which are irregular in their shape, and of a red, livid color. In their size they vary between a pea and a walnut: they are either painful or indolent; and, as they grow older, they gradually assume a dirty bronze complexion, at the same time that they acquire a greater degree of hardness and density. When ulceration sets in, they become the seat of ill-conditioned sores, discharging a thin, sanguous fluid, which concretes into thick, adherent, blackish crusts. The most common seat of the disease is the face, the ear, nose, shoulder, buttock, and leg, which are often hideously distorted, both from the immense number of tumors, from the furrowed state of the skin, and from the great swelling of the subjacent cellular substance. Does elephantiasis consist in a hypertrophied state of the cutaneous papillæ? This is highly probable; nevertheless, the question has not yet been determined by dissection. This disease is generally complicated with other affections, and is almost always incurable: Alibert asserts that it is occasionally hereditary. It occurs indiscriminately in adults of both sexes.

Framboësia, vulgarly called *yaws*, is a chronic tubercular disease, indigenous in Africa, and extremely common in America and the West Indies. Although contagious, it can only be communicated by immediate contact, and is infinitely

more frequent amongst blacks than whites. The period which elapses between the reception of the virus and the commencement of the eruption is not accurately determined, but does not probably exceed several weeks. The disease affects the same person only once during life, and children are more obnoxious to it than adults.

The eruption, which is generally preceded by slight constitutional symptoms, and which appears successively on different regions of the body, is characterized by minute flea-bite-looking pimples; to which succeed irregular, prominent tubercles, which often present the shape, color, and size of a raspberry,—a circumstance from which the disease has obtained its name. The vegetations thus formed are usually distinct at their summit, but almost always united at the base: they are firm, and indolent, and covered with thin, dry, and adherent scales. Finally, after remaining stationary for weeks, months, or even years, they inflame, become soft, and spongy, and give rise to deep, foul ulcers, from which there is a constant discharge of a yellowish, acrid, and offensive fluid, which soon concretes into pretty thick scabs. Their most common seat is the head; but they also occur, though less frequently, in the axilla and groin, around the anus, on the scrotum, and on the pudendal lips. They likewise appear on the shoulders, buttocks, and limbs; but the scalp, forehead, and temples, scabbed and hideously disfigured, are the parts, of all others, which suffer most frequently.

The last affection that we shall notice under this head is *lupus*. This is a truly malignant disease, seated, for the most part, on the nose, cheek, and chin, and which, if allowed to progress, successively destroys the cutaneous and cellular tissues, and finally the cartilages and bones. It usually commences in a small red point, which is hard and prominent, and appears to affect only the more superficial layers of the skin. The progress of the tubercle is slow and gradual, a long time often elapsing before it attains its full developement. By and by, however, ulceration and scabbing commence: the sore is bathed with sanguous matter, its edges are raised and indurated, and its bottom exhibits a foul, livid aspect. The tendency of the disease is to spread, both in depth and in diameter; hence it frequently happens that it invades a large extent of surface, and produces the most frightful ravages. The ulcer sometimes spontaneously heals,—the part of the skin over which the disease has passed remaining hard and red, like the cicatrix of a superficial burn.

The number of tubercles varies. Most generally there is only one, but now and then there are a great many, almost the whole face being covered with them. During the ulcerative stage, considerable pain attends, the skin becomes hypertrophied, and the cellular tissue is distended with sero-albuminous matter. The disease is equally frequent in both sexes, and is rarely met with after the fortieth year. Persons of a scrofulous diathesis are particularly subject to it.

7. *Scaly Diseases.* The scaly diseases, located in the outer surface of the corion, are characterized by the development of red spots, elevations, or blotches, over which the scarf-skin, dry, opaque, and thickened, incessantly exfoliates and reappears, the process of renovation and decay sometimes going on for years. Easily distinguishable from the crusts which attend vesicular affections, they generally proceed in a slow and insidious manner, unaccompanied with much local or constitutional disturbance; and, although they are rarely dangerous, they are always very disagreeable, as they have a tendency, especially if protracted, not only to disfigure the skin, but seriously impede the movements of the joints. Four genera of lesions have been described under this order by Willan, Bateman, and others; namely, lepra, pityriasis, ichthyosis, and psoriasis. To these may be added a fifth, namely, pellagra.

Lepra most commonly attacks the arms and legs, especially the superficial parts below the elbows and knees: it sometimes occurs on the hairy scalp, but seldom exclusively. Commencing in small, red, shining points, scarcely elevated above the level of the skin, it soon forms pretty large patches, often an inch and a half in diameter, of an orbicular shape, disjoined or confluent, slightly depressed in the centre, and surrounded by a florid, prominent circle, from one to several lines in width. The epidermic scales are at first thin, smooth, polished, and transparent; but, in the course of a few days, they are replaced by others, which are lamelliform, hard, tough, opalescent, pearly, or of a pale straw-color. These scales fall off, and are incessantly renewed, the surface beneath them being somewhat rosy and inflamed, smooth in recent, and occasionally deeply chapped in old cases.

This disease sometimes gets well spontaneously, the skin from which the scales are detached acquiring at first a peculiar grayish color, which sometimes persists for a considerable period afterwards. In the majority of cases, however, it

slowly pursues its career, producing more or less thickening of the skin, and impairment of the locomotive powers. When leprosy is generally diffused, Bateman states that there is often considerable cutaneous inflammation, accompanied with extreme soreness, pain, and stiffness, amounting to such a degree sometimes as to render the motions of the joints impracticable, and confining the patient to his bed.* According to the same authority, the nails of the toes and fingers are frequently much thickened, opaque, of a dirty yellowish color, incurvated at the extremities, and very irregular on the surface; yet, even under all these circumstances, there is rarely much constitutional disturbance.

Pityriasis is a superficial inflammation of the corion, — chronic, non-contagious, and attended with an exfoliation of the epidermis, in the form of very thin, irregular, whitish scales, which are reproduced in great numbers and with astonishing rapidity. Considerable pruritus often attends this affection, leading to an irresistible desire to scratch. Sometimes the cuticle comes away in a mealy, furfuraceous, or pulverulent desquamation; and, in the generality of cases, the corion is singularly discolored, sometimes of a copper tint, brownish, or almost black. The scales, whatever may be their size and form, are always dry, easily detached, and spread over a large surface, the affected part being often many inches in diameter, and interspersed with portions of sound skin. The most common seats of pityriasis are the scalp, eyebrows, breast, and epigastric region, together with the arms and shoulders.

Ichthyosis is a chronic, cutaneous affection, appearing in large continuous patches, which occasionally cover the greater part of the body. It is characterized by the formation of thick, rough scales, of a grayish-white color, and almost horny texture, without pain, heat or pruritus, and without the deciduous exfoliations which belong to lepra and psoriasis. The whole skin seems to be deeply involved in this affection; and hence, in the advanced stages, it is generally in an extremely dry, stiff, and uncomfortable condition, at the same time that it is greatly hypertrophied and almost of gristly hardness, the different layers of which it is composed being no longer distinguishable from each other. In regard to their form, the epidermic scales present almost innumerable pecu-

* Practical Synopsis of Cutaneous Diseases, p. 26. Second edit. Phila. 1821.

liarities. Sometimes they are of uniform thickness, and seem to be merely elevations of the common lozenges of the cuticle ; sometimes they are flat, thin, and imbricated ; sometimes they have short rounded necks, with broad irregular tops ; and occasionally, again, though very rarely, they sprout out in the form of excrescences, of a horny texture, and most grotesque appearance. The quantity of these morbid excretions is, in some instances, immense, the whole body being literally encased with them like a shell. In old, inveterate cases, a considerable amount of calcareous matter is frequently poured out, both upon the surface of the scales, and in the intervals between them.

The color of the scales varies not only in different subjects, but frequently in different parts of the same individual. As was before stated, most of them are of a grayish white ; but, in many instances, they are brownish, greenish, or blackish. They have also been known to exhibit a shining, pearly aspect, and to be surrounded by a blackish-looking border.

During the warm weather of summer, this disease sometimes nearly disappears, the scales dropping off in large quantities, especially at night. It is usually aggravated by arid states of the atmosphere, and is always most troublesome during the severe cold of winter. Unpleasant sores sometimes attend ichthyosis, more or less painful, prurient, and discharging a thin, acrid humor : the general health is usually much impaired, and, occasionally, the whole body is said to emit a peculiar, fishy exhalation.* Occasionally, the patient is harassed with pustular eruptions.

Ichthyosis generally begins very early in life ; and, in a number of instances, it has been known to be hereditary. This fact is strikingly illustrated by the curious and instructive cases published, several years ago, by Professor Francis, of New York.† The most usual seats of the disease are the outer regions of the extremities, both upper and lower, the sides of the trunk, and the shoulders. The flexures of the joints, and the inner surface of the thighs, are seldom affected with it.

Psoriasis, vulgarly called the *scaly tetter*, consists of solid, inflammatory elevations of the skin, forming various-sized patches, isolated or united, covered with thin, white, shining

* See Sauvage's *Nosologia Method.*

† *American Journal of the Medical Sciences*, August, 1828.

scabs, and commonly accompanied by some constitutional symptoms. The eruption sometimes affects a peculiarly tortuous, serpentine shape: in other instances, especially when it breaks out on the lips, it pursues a circular direction, ring after ring forming regularly beyond the surface last attacked. The corion is generally somewhat rosaceous, and, in bad cases, considerably thickened and chapped: a very disagreeable itching, attended occasionally with a good deal of pain, is pretty constantly present; and the scales, seldom very adherent, are frequently detached and reproduced. Sometimes the eruption is entirely confined to the limbs; at others, it covers the whole body; and, in such cases, the patient appears, in the language of Cazenave and Schedel, to be literally enclosed in a squamous envelope. Occasionally, the nails split, become yellow, and at length fall off; and the least movement frequently produces rents in the skin, followed by a flow of blood.* Occurring at all ages, it is liable to disappear, and recur at certain seasons; and, in some individuals, it never entirely ceases.

The fifth and last disease we have proposed to notice under the present head is *pellagra*. It is very common in certain districts of Italy, where it sometimes prevails epidemically, especially during spring and summer, but is entirely unknown in this country. Adults alone suffer, and both sexes are equally liable to it. Its course, which is always chronic, lasts from one to several years, the complaint becoming annually more and more aggravated, until the unfortunate patient, harassed and disfigured, finally sinks beneath its blighting influence. Dissection always discloses extensive lesion of the internal organs, particularly of the alimentary canal.

More or less constitutional derangement usually precedes this affection, which manifests itself by small, red, shining spots, accompanied with slight tumefaction of the skin, together with a sense of fulness and tension. By degrees, the color of these spots becomes deeper; their surface is covered with thin scales; and, as they augment in size, they unite, and form large, irregular-shaped patches. The skin, meanwhile, is not only considerably thickened, but disfigured with deep rents and fissures. After remaining in this state for some time, the scales gradually drop off, disclosing a red,

* Cazenave and Schedel, Practical Synopsis, p. 259.

glossy surface, from which there is a constant bran-like exfoliation of the epidermis. The neck and limbs are the parts most usually affected.

8. *Syphilitic Diseases.* The last group of diseases that we shall notice is the syphilitic. The disorders comprehended under this appellation, caused by the influence of the venereal virus, manifest themselves under at least six varieties of form,—the exanthematous, vesicular, pustular, tubercular, papular, and scaly. They are occasionally *primary*; that is to say, they appear simultaneously with the affection of the genital organs; but, in the great majority of cases, they are not developed until some time subsequently,—generally not under a few months; and they are therefore said to be *consecutive*. The eruptions appertaining to this group usually pursue a chronic course, are circular in their form, and present a characteristic copper color: though occurring on all parts of the body, they are principally observed on the forehead, nose, cheek, back, and shoulder, and are attended with thin, grayish scales, or with hard, thick, greenish scabs.

In the *exanthematous* form, the spots are of a circular shape, and about the size of a quarter of a dollar: they are almost always situated on the trunk and extremities, are of a dark copper color, do not disappear under pressure, are never confluent, and generally terminate by a slight exfoliation of the epidermis. Cazenave and Schedel describe a variety of this eruption, which is characterized by small, irregular, grayish spots, of a deeper red than the preceding, more transient, slightly confluent, and disappearing, though slowly, under the pressure of the finger.

The *vesicular* form is extremely rare. Rayer gives only a solitary example of it; Cazenave and Schedel also saw it but once; and Biett never met with it, except on three or four occasions. It begins in minute, circumscribed pimples, scattered over different parts of the body, to which succeed small vesicles, filled with a transparent fluid, and surrounded by a red, copper-colored areola: their progress is very slow, and their contents are either absorbed, or they concrete into thin scales, which, falling off at different intervals, leave the surface of a dingy, yellowish hue. The vesicles are sometimes extremely numerous, and cover nearly the whole body.

The third form of syphilitic disease is the *pustular*. This variety, as the name indicates, is characterized by the presence of small tumors, containing an ichorous, serous, or puru-

lent fluid. Their size and shape are subject to considerable diversity. Occasionally, they are as big as a hazelnut; but, under ordinary circumstances, they do not exceed the volume of a common pea, and, indeed, are seldom so large. In their shape, they are sometimes conical, sometimes oval, sometimes pediculated, sometimes rounded, and sometimes flattened, with a minute, central depression. Now and then, all these varieties are observable in the same individual. Their number is often immense, hundreds being scattered over a small extent of surface; and, as they form successively, they may be seen and studied in every stage of their developement. Each pustule reposes upon a hard, copper-colored base: its internal structure is not known: it appears to be not unlike that of small-pox.

After remaining for a short period, the contents of the pustules escape, concrete, and form hard, thick scabs, of a dark color, pretty firmly adherent, and sometimes circularly furrowed. In mild cases, the scabs fall off soon, and leave merely a chronic induration, a livid or grayish stain, or a slight cicatrix: in severe ones, on the contrary, deep, circular ulcers are exposed, with a foul, grayish bottom, and a hard, purple, and regularly-defined margin. In cases of the latter description, the scabs are frequently renewed, and are finally replaced by round, indelible scars.

In the *tubercular* form—the most frequent, perhaps, of all—the eruption consists of small, red, copper-colored eminences, varying in size, between that of a mustard-seed and an olive. Of a rounded, flattened, or conoidal shape, they are either isolated, assembled into groups, or arranged into perfect circles: they are smooth and polished, produce little or no pain, and become covered, in a short time, with a dry, scaly incrustation, which is generally reproduced as fast as it falls off.

In the more aggravated forms of this variety of syphilis, the tubercles are inordinately large, prominent, of a deep violet hue, from three to nine lines in length, and encircled by a well-marked, copper-colored areola. After continuing thus for some time, varying from a few months to several years, they become painful, inflame, suppurate, and are replaced by deep, foul, irregular ulcers, reposing upon a hard, purple base. A thick scab usually covers these erosions, which is repeatedly renewed, disclosing, each time that it is detached, that the sore is extending its ravages. When the

tubercles are numerous, the ulcers, running together, often acquire a frightful size, and, on healing, leave disfiguring cicatrices.

Papular syphilis is characterized by the occurrence of small, hard, solid elevations, containing no fluid, and terminating almost always in desquamation, seldom in ulceration, or in the formation of scabs. Of the two varieties of this affection described by authors, one is acute and primary, the other chronic and secondary.

In the first variety, which, according to Carmichael and others, sometimes accompanies gonorrhœa, the eruption appears simultaneously on different regions of the body, and is completed in about forty-eight hours from the time of its first invasion. The papulæ are extremely small, disjoined or grouped, of a red copper color, and of a slightly conical shape, being surrounded, here and there, by violet areolæ, which are often confluent, and give the surface a characteristic yellow tinge. Ulceration rarely attacks these papillæ: they disappear in a short time, and are followed by a furfuraceous desquamation of the cuticle.

In the other variety, the eruption is developed in a slow and successive manner, being announced by small yellow spots, which are particularly numerous on the forehead, scalp, and extremities. The papulæ, which are of a light copper color, are larger than the preceding, flat, of the size of small beans, grouped, and devoid of an areola. In time, the summit of each elevation becomes covered with a dry, grayish pellicle, which is regenerated as fast as it desquamates, until the disease finally entirely subsides. Meanwhile, the skin between the agglomerated papulæ undergoes important changes: it assumes a dingy, yellowish color, has a dry, shriveled aspect, and is the seat of a constant exfoliation of the cuticle.

The sixth and last form of syphilitic disease which we have proposed to notice is the *scaly*, which manifests itself, as the name imports, by dry, grayish imbrications, situated on small, copper-colored elevations. This variety, which is always consecutive, persists for a long time, and terminates by desquamation. The eruption, in the plurality of cases, appears in patches, which, although they may occur on all parts of the cutaneous surface, are most common on the forehead, scalp, and face. They are from four to eight lines in diameter, in shape irregularly rounded, ordinarily isolated,

smooth, polished, and somewhat elevated: each is covered with a thin, hard, whitish scale, which is very slightly adherent, and which, on falling off, exposes a small, shining, copper-colored eminence.

9. *Stains.* There are certain discolorations of the skin, which, from the frequency of their occurrence, rather than from any pathological interest, require to be mentioned in this place. Of these, the principal are ephelis, lentigo, albinism, and nigrism. They are seated in the vascular net-work of the skin, and no doubt depend upon some alteration of the coloring matter: some of these stains are congenital, and it is a singular fact that they seldom affect the whole cutaneous surface. Their duration varies from several weeks to many years.

Lentigo, generally known by the name of *freckles*, is characterized by yellowish, fawn-colored spots, varying in size, from a pin-head to that of five cent piece: they are most common on the face, neck, chest, and hands, in persons with light eyes, and red hair; are usually congenital, and last through life. When the spots are very numerous, they sometimes run into each other, and thus form large irregular-shaped patches.

In *ephelis*, the stains are of a yellow saffron-color, very irregular in shape, and much larger than in lentigo. Their most common situation is the neck, the anterior part of the trunk, and the inside of the thigh: they are never observed on the face, except during pregnancy, on which they are a frequent attendant. The spots which are often preceded and accompanied by considerable itching, are at first of a grayish color, small, and rounded: by degrees they assume a yellow tint, augment in size, and, from being isolated, they unite and form large, irregular patches: their duration varies from a few days to several months, and their disappearance is frequently followed by a slight exfoliation of the epidermis.

The skin is sometimes converted into a dead, milky-white color, constituting what is termed *albinism*. This change, which is confined to no particular race, depends not upon the absence of the pigment, but rather, I apprehend, upon some modification of its component elements. Persons who present this peculiarity differ, in many respects, from ordinary individuals. Their whole organization, both mental and physical, seems to be imperfect; the body is covered with a soft, silky down; the hair is often of a snow-white color; the eyes are feeble, and unable to bear the light; and the iris and

choroïd are of a light rosy tint, from the absence of black pigment.

There is a variety of albinism, which is limited to particular regions of the body, usually the head and trunk, to which the term *vitiligo* has been applied. It commences in small, milk-white spots, which go on enlarging until they sometimes cover the whole surface. The spots are generally oval or rounded, and now and then they have an irregularly striated arrangement. When the disease occurs on the scalp, axilla, and pubes, the hair participates in it, and becomes deprived of its natural color. Negroes who exhibit this peculiarity are called piebald.

Nigritism is the term employed to designate the reverse of the condition just described. The affection is generally local, appearing in small, irregular-shaped patches, from one to several inches in diameter; and the parts of the body most subject to it are the genital organs of the male, together with the nipples of the female. The face is also sometimes the seat of it. Of this, the singular case recorded by Leeat, affords a striking illustration. The patient was a lady, about thirty years of age. The discoloration was first observed in the seventh month of her pregnancy, commencing on the forehead in a grayish, dusky-looking spot, and extending by degrees over the whole face, except the eyes and the margins of the lips, which retained their natural complexion. The altered skin was very tender to the touch, but in other respects the lady suffered no inconvenience. The black color disappeared two days after delivery, with a profuse perspiration, by which the sheets were stained black. The same phenomenon was witnessed during several succeeding pregnancies.* Cases of an analogous kind have been reported by Chomel, Goodwin, Rostan, Rayer, and other writers. The affection has hitherto been observed principally in females.

It is well known that the nitrate of silver, if administered for a long time, has the effect of imparting a gray slate-color, not only to the skin, but also to accidental ciatrices, the conjunctiva, and to the mucous membrane of the alimentary tube. The discoloration generally remains during life, and is always most conspicuous on the surfaces exposed to the light and air, as the face, neck, and hand. How this change is produced, the present state of our knowledge does not enable us to ex-

* *Traité de la Peau Humaine*, p. 136. Amsterdam, 1765.

plain. The most plausible conjecture is, that the coloring matter of the skin has a special affinity for the substance in question, by which they combine with each other, at the same time that they undergo some alteration in their properties. What gives countenance to this idea is, that the color remains after boiling, and that no impression can be made upon it by medicine. Mr. Brande asserts that he has detected oxide of silver in the stained organs. It should be added, that the discoloration produced by this substance is occasionally of a dirty bronze appearance.

As appendages to those of the skin, it will be proper here to notice the principal lesions of the nails and hairs, though so little is known respecting them, that our account must necessarily be meagre and imperfect.

SECTION II.

Of the Nails.

THE *nails*, situated on the dorsal surface of the fingers and toes, with which they correspond in number, are formed of a homogeneous substance of the same nature as horn. Their chemical properties are those of coagulated albumen, with the addition of a minute quantity of phosphate of lime, to which they are chiefly indebted for their hardness. In the sound state, the nails are semi-transparent, flexible, and elastic: each has a root, a body, and a free extremity.

The root forms about the sixth part of the entire nail: it is very thin and soft, of a white color, and is inserted into a groove of the dermis, at the same time that it is covered by a reflection of the cuticle. The body, intermediate between the root and the free extremity, is of considerable thickness, and constitutes by far the greater portion of the organ. Of its two surfaces, the external is longitudinally grooved, and transversely convex; the other is concave, also furrowed, and closely adherent to the true skin. The free extremity is the thickest and strongest part of the nail: it projects a short distance beyond the end of the finger, and is usually somewhat incurvated.

The most interesting structure about the nails is the ap-

paratus determining their growth and direction. This is a peculiar papillary substance, from a quarter to a third of an inch in length, situated at their posterior extremity: it presents a linear, striated surface, is extremely sensitive, and of a florid color from the immense quantity of its capillaries. When this apparatus is destroyed, no further growth takes place. The nails themselves have neither vessels nor nerves; none at least have ever been traced into them.

When a nail is torn away, it is gradually regenerated,—the period required for this purpose varying from three to six months, according to its size, and the violence inflicted upon the secreting apparatus. Eight or ten years ago, I received a severe contusion on my left thumb, the consequence of which was an exfoliation of the corresponding nail. As the old nail became detached, a new one gradually formed, and, in six months from the time of the injury, had acquired its full size and development.

Inordinate length of the nails is of very common occurrence, and would be still more so, were it not for the constant paring to which they are subjected. Left to themselves, they sometimes grow to the distance of three, four, or five inches, pursuing a tortuous, spiral course, so that they occasionally bear a much closer resemblance to claws than to nails, (Fig. 43.) Their thickness, under such circumstances, is generally considerably augmented, from the superaddition of lamellæ, which often overlap each other, like the scales of a fish. The extension and thickening of the nails form a prominent feature in ichthyosis, leprosy, and elephantiasis. The nails, in these diseases, after having acquired a certain length, sometimes fall off, and are reproduced, though seldom perfectly. They are even said to become painful, so that they can be no longer cut, which, however, is doubtful. In Polish plait, the nails both of the fingers and toes, often acquire a great size, and a yellowish, livid, or black complexion.

Fig. 43.



The nails are sometimes, though very rarely, entirely absent, as a congenital defect. More frequently, they are unusually small, or developed imperfectly, their place being supplied by thick, horny cuticle. On herpetic persons, I have repeatedly found them very short, scaly, and of a thick, rounded, button-like form. In strumous subjects, they are sometimes deeply grooved, enlarged, and of an indurated, horny consistence. In protracted paralysis, the nails are said to grow very slowly and imperfectly, probably from a deficiency of nervous energy.

A *vicious situation* is occasionally observed. Thomas Bartholin has recorded an instance * where the nails occupied the anterior extremity of the metacarpus, the fingers being absent. In other cases, they occupy the lateral surfaces of the fingers; and occasionally, though very rarely, they have been reproduced on the second or first joint, after the partial or complete loss of the part on which they are naturally situated.

In monsters, the nails of the fingers are sometimes consolidated. The same deformity has been observed in adults. Otto saw a case of this kind, in which the four outer nails of both hands were united into one. In pulmonary phthisis, the nails are almost always incurvated,—a fact which did not escape the observation of Hippocrates, and which has been noticed by every practitioner of medicine since his time.

The nails, as we have already seen, are the product of a soft, pulpy, vascular apparatus, which is situated at their roots, and may, from its office, be denominated the *ungueal matrix*. The structure here referred to is subject to various degrees of inflammation, attended with corresponding alterations of the organs under consideration. The causes of this disease, which I shall name *onyxitis*, are sometimes of a local but more frequently of a constitutional character. Amongst the latter, is a scrofulous, gouty, or syphilitic taint, which often exerts its influence for a very long time, and baffles our best-directed efforts for its removal.

Onyxitis commences in a circumscribed swelling of the ungueal matrix, with pain and deep redness. In a short time, a thin, ichorous fluid issues from the cleft at the root of the nail, and at last the soft parts give way. The ulcer is very small at first, but gradually extends, until it finally involves the whole of the ungueal matrix, together with a

* Hist. Anat. t. i. 291.

portion of the dermis immediately around it. The surface is brown and glossy, the margin thin and sharp, and the discharge fetid and irritating. The pain is sometimes intense; at other times the disease is more indolent, and accompanied with little uneasiness. The nail is formed very imperfectly; it loses its natural form and color, becomes irregular, dry, black, and at length falls off. When this happens, it is seldom completely regenerated. The surrounding skin is tense and livid, the affected extremity assumes a bulbous appearance, exceeding often double the normal size, and, in cases of long standing, the disease sometimes invades the subjacent bone. Onyxitis occurs chiefly in young persons, and attacks the thumb more frequently than the fingers or toes.* It may continue for years.

SECTION III.

Of the Hairs.

ALTHOUGH the hairs bear a general resemblance to the nails, yet they differ from them in several essential particulars. Like the organs just mentioned, they are of a horny consistence, but their color is darker, and their chemical composition more complex. Besides an albuminous matter, which forms the basis of both, Vauquelin detected in the former, a small quantity of oil, phosphate and carbonate of lime, oxide of manganese, iron, silex, and sulphur.

With the exception of the palm of the hand and the sole of the foot, hairs are found upon almost every part of the body. In some regions, they are coarser than in others, and hence the distinction of them into two kinds,—the crinal and pilar. The former grow on the scalp, the latter on the eyebrow, the margin of the eyelid, and on the body. Not only are the crinal hairs finer than the pilar, but they differ from them still further in regard to the time of their full developement, their color, and their length.

* For an excellent account of this disease, the reader may consult the paper of Mr. Wardrop, of Edinburgh, published in the fifth volume of the London Medico-Chirurgical Transactions. He has described it under the name of *onychia maligna*, from the obstinacy and malignity of its character.

A hair consists of a follicle and stem. The follicle is a sort of an ovoidal cup, occupying the substance of the dermis, which it traverses obliquely. Being perforated at both extremities, at one for the exit of the stem, and at the other for the entrance of vessels and nerves, it is composed of two tunics, closely united together, but widely different in structure. The outer membrane is white, firm, and intimately adherent to the dermis; the inner one, on the contrary, is reddish, extremely soft, and apparently continuous with the rete mucosum. Within this delicate lamella is the proper secreting organ of the hair, which is of a conical form, highly vascular and sensitive, and bears a very near resemblance to the pulp of a tooth.

The stem varies in length as well as in thickness, in different regions of the body. It is of a conical shape, and of a dark color. One extremity is free, hard, and sometimes bifid; the other is soft, white, and hollowed out, so as to embrace the central pulp on which it grows, the part which is first secreted being forced on by that which exudes last. The intermediate portion is a diaphanous, horny sheath, containing a dark, spongy, filamentous substance. It is either straight, twisted, or curled.

The piliferous follicle, as was before stated, is implanted in the substance of the dermis, by which it is protected and kept in place. To secure it still further, the cuticle enters the external opening of the follicle, from whence, after having lined its margin, it is reflected upon the surface of the stem, upon which it is soon lost.

With regard to the vitality of the piliferous follicle, there is no doubt; but, in respect to that of the stem, it is a matter of inference rather than of observation. It is uncertain whether the vessels of the secreting pulp are or are not, in the natural state, continued into the stem, so as to extend into its substance beyond the level of the cutaneous surface. In endeavoring to decide this question, reliance is to be placed mainly upon analogy and upon what occurs in disease. In phrenitis, the hair has been so sensible after an injury, that the slightest touch gave severe pain; and, on clipping a stem, unseen by the patient, this was instantly felt, and occasioned a paroxysm of rage.* In the Polish plait—a disease which will be more particularly described in another paragraph—

* Elliotson's Human Physiology, p. 277. Fifth edition. London, 1835.

the hair, it is said, sometimes bleeds ; and, if this is true, it is surely more consonant with the principles of sound physiology to suppose that the blood proceeds from preëxisting vessels than from vessels of new formation. So much for what has been noticed in disease.

If we appeal to analogy, we shall find that the hoof of the horse and other animals, although apparently unorganized, is abundantly supplied with vessels, not less so than the quills and feathers of birds. If the pulps of the quills of the porcupine be well injected, vascular lines may be traced into the structure to almost any distance, and the same may be seen, even without the aid of a magnifying-glass, in the growing feathers of our domestic fowls. The horn of the ox, when broken or sawed off, will occasionally cicatrize. Of this, a beautiful specimen is contained in my museum of morbid anatomy. It is about three inches long, and had evidently been broken when the animal was only a few years old. If we connect these facts with the circumstance, perfectly attested by many highly respectable authorities, of the hair losing its color in the course of twenty-four hours, the probability is strong that the structure under consideration is organized, though less perfectly, perhaps, than almost any other in the body. In the African lion, I have succeeded in tracing filaments of the fifth pair of nerves into the bulb of the whisker ; and the same thing has been done by Rudolphi in regard to the mustachioes of the seal.

Most of the lesions of the hairs are directly referable to inflammation of their follicles. In the plurality of cases, the inflammation pursues a chronic course ; but what particular changes the structures in question undergo, is by no means ascertained. It is altogether probable that the piliferous follicles are considerably swollen and injected, and that their power of secretion is either suspended, or at all events very greatly modified ; so that the stem, instead of presenting its normal characters, is variously altered, both in its consistence, its length, and thickness, and, above all, in its color.

The *Polish plait*, as it is termed, a disease which is endemic in Poland, Lithuania, and Tartary, seems to be an inflammatory affection. It generally attacks an immense number of piliferous follicles, which in a short time acquire an extraordinary size : they rise above the level of the skin, are painful on the slightest touch, and exude a large quantity

of viscid, brownish, and offensive matter, by which the hairs are matted and glued into inextricable tangles, of great length. Even the stems are said to be swollen and increased in thickness ; their cavity is also larger than in the sound state, and their areolar texture is rendered unusually distinct. Dr. Schlegel, a German author, assures us that, in a case of the Polish plait, he found all the hairs of the body not only tumefied, but distended with yellowish-brown fluid, and at least six times as large as in the normal state. This disease generally appears during the autumnal months, is observed chiefly in the lower classes, and is often extremely obstinate and persisting. Although the hairs of the head, generally alone suffer, yet those of the beard, axilla, and pubes, are sometimes similarly affected. It has been already intimated, that the hairs occasionally bleed in this disorder. This, however, is still a litigated point, and one which can only be decided by further observation. The late Professor Meckel, of Halle, carefully injected the scalps of two persons that died while laboring under the Polish plait, and in neither did he succeed in throwing any of the fluid into the matted mass or horny portion of the hair. These experiments, however, are far from being conclusive ; for it is obvious that vessels might have existed in the parts referred to, and yet, owing to their extreme minuteness, the artificial fluid might have failed in reaching them.

When the hairs are plucked out, they are always regenerated, provided the secreting pulp remains unimpaired. When this structure is injured, the new growth is proportionably slow and imperfect. In old age, the piliferous sacs undergo a sort of *atrophy* ; they lose their energy, diminish in size, and are at length completely annihilated. The same phenomena occurs in certain diseases, as, for instance, biliary fever, scarlatina, psoriasis, and secondary syphilis. The falling of the hairs is often temporary, and probably depends upon some transient disease of the piliferous follicles. A few years ago, a friend of mine, after recovering from a severe attack of scarlatina, lost every hair on the body ; in a few months, new ones sprung up, and in time acquired all the characters of the former. Persons seldom grow bald all at once. The crown of the head is generally affected first, whence the depilation gradually extends in different directions. The piliferous follicles in this affection seem to die gradually ; for, after the original hairs have dropped off, a new crop frequently

appears, consisting of a thin, soft, whitish down, evidently formed by feeble attempts at reproduction.

Another affection of the hair is *hypertrophy*. This is most frequently observed on the head, but may also occur on other parts of the body, as the beard and pubes. The most remarkable case of hypertrophy of the hair of the head, of which I have any knowledge, occurred in a friend of mine, a young lady about twenty years of age. From her earliest youth she was subject to cephalalgia, but did not appear otherwise unwell. Her complexion was unusually fair, her eyes light, and her hair of a flaxen hue. In consequence of her constant headaches, the hair was commonly kept short; but, to effect this, as it grew with such extraordinary rapidity, it was necessary to cut it every few weeks. Within a year of her death, her general health gradually declined, without any assignable cause, save the astonishing developement of the hair, attended with severe cephalalgia. During the last three months, the hair, although it had been cut only a short time before, reached nearly down to the heel, and had a soft, oily feel: the pain in the head increased in violence, the countenance became blanched and almost transparent, and she died gradually exhausted, having, within a few days of her dissolution, exhibited symptoms of acute phrenitis. On examination after death, the only remarkable circumstance observed was a slight accumulation of water in the ventricles, and on the base of the brain. It is impossible to doubt that this abnormal growth of the hair depended on hypertrophy of their follicles, inviting constantly an excess of blood to the head at the expense of the rest of the system. This is proved by the extraordinary developement of the hair, by the obstinacy of the cephalalgia, and by the symptoms which were present during the last few months of the young lady's illness. The particular state of the piliferous follicles was not ascertained.

Scarcely less extraordinary is the developement of the beard in the female. Of this species of hypertrophy not a few examples are recorded by authors. One that came under my own observation I will here mention. The woman, who is the mother of a numerous offspring, is seventy-eight years of age, and has always enjoyed excellent health. The sides of the face, chin, and lips are all thickly covered with coarse hair, which she is obliged to shave off regularly once a week. Her whole aspect is remarkably masculine; and, but for the

length of the hair of the head, she might be easily mistaken for a male. The hair of the pubes sometimes attains an extraordinary developement, forming long, thick tufts; and similar appearances have been witnessed on the shoulders and buttocks.

The hair often loses its normal formings, hanging about the head in soft, straight locks. Dr. Elliotson, of London, refers to several cases in which the hair could not be kept in curl if there was the slightest indisposition; and similar examples have been recorded by Alibert, and other writers. On the other hand, an instance is narrated in which it always curled in a fit of the gout.*

There are cases, again, wherein the hair, in consequence of some imperfection in its growth, becomes remarkably brittle. A curious case is recorded by Mr. Mayo, of England, of a young lady, whose hair, without any assignable cause, suddenly broke, at a quarter of an inch from the head, and fell off in large locks. This singular process was repeated every three or four weeks. She was subject to a severe headache, but in other respects her health appeared to be perfectly good.†

A change of color of the hair is a natural consequence of old age, but it also occurs in different diseases, and from the influence of the depressing passions, such as grief and fear. What alterations the pilous system undergoes under such circumstances, we have no data to determine. The discoloration, though for the most part gradual, has been known to take place in the course of twenty-four hours. When caused by age, it generally begins at the loose extremities; and the same fact is observed in animals which change their complexion for the winter. The restoration of color, on the contrary, always commences at the root.

An accidental developement of hairs is not uncommon. This is often seen upon congenital moles, as well as upon parts of the skin that have been for a considerable period in a state of irritation. As occurring in the stomach, bowels, and urinary bladder, numerous cases have been recorded by Haller and other authors. They have also been found in the gall-bladder, in cutaneous tumors, and in the ovary. In the

* Human Physiology, p. 277.

† Outlines of Human Physiology, p. 468.

latter organ they generally coexist with dropsical accumulations, carcinoma, or extra-uterine foetation, and hence they are almost always accompanied by adipocirous matter, by teeth, and by pieces of bone. In most of the situations here specified, though not in all, they perfectly resemble the normal hairs, both in their color, and in their structure, being composed of distinct roots and stems. Concerning their mode of origin, however, we have no positive information ; and in the absence of exact facts I refrain from offering conjectures.

CHAPTER XI.

Of the Nervous System.

SECTION I.

General Observations.

I. *General Observations.* — Cerebral Envelopes. — Cephalo-spinal Liquid. — White and Gray Substances. — Chemical Composition. — Consistence. — Color. — Sensibility. — Vascularity. — Absorbent Vessels. — Speculations of Kellie and Abercrombie, respecting the Compressibility of the Cerebral Tissue. — Weight of the Encephalon and Form of the Spinal Cord. — II. *Lesions of the Cerebral Envelopes.* — Inflammation of the Dura Mater. — Suppuration. — Fibrous Tumors. — Bony Deposits. — Hypertrophy of the Glands of Pacchioni. — Arachnitis. — Hydrocephalus. — Tubercles. — Stages and Symptoms of Arachnitis. — Diseases of the Pia Mater. — III. *Lesions of the Brain.* — Wounds. — Encephalitis. — Suppuration. — Abscesses. — Gangrene. — Softening. — Chronic Inflammation. — Induration. — Ulceration. — Sanguineous Effusions. — Tubercles. — Melanosis. — Encephaloid. — Cartilaginous Formations. — Calcareous Deposits. — Cysts and Hydatids. — Hypertrophy and Atrophy. — IV. *Lesions of the Spinal Cord.* — Inflammation. — Heterologous Formations. — Hydro-rachitis. — V. *Lesions of the Nerves.* — Classification. — Form. — Distribution. — Connection and Structure. — Restorative Power. — Neuritis. — Suppuration. — Ulceration. — Hypertrophy and Atrophy. — Diseases of the Nervous Ganglia.

IT will not be amiss, before we proceed to speak of the diseases of the cerebro-spinal axis, to prefix a short account of the organization and normal characters of this portion of the nervous system, as, without some information of this sort, it will be impossible to place the subject in a proper point of view, or to enable the reader to arrive at a positive conclusion in regard to some of the more intricate topics that are comprised under it. Our materials for illustrating this branch of our inquiry are not of the most satisfactory kind; much remains to be done; the field is almost unexplored, and further investigations are not only necessary, but absolutely indispensable to the true interests of cerebral pathology.

The cerebro-spinal axis consists of three parts, not separate and independent, indeed, of each other, but closely connected

together by continuity of substance, namely, the cerebrum, cerebellum, and spinal cord. Situated in the cranial and vertebral cavities, these organs are surrounded by different membranes, and wrought into a variety of figurate bodices, which are perfectly alike on each side of the median line. These structures have always formed an interesting subject of study with the special anatominist; but, as a description of them would be out of place here, it will be sufficient to remark concerning them, that they impart to the cerebro-spinal axis the character of plural organs, each of which, there is every reason to conclude, presides over a particular function, with the precise nature of which we are still unacquainted.

Of the envelopes of the brain and spinal cord, the pia mater, as it is termed, is by far the most important, as it is upon it that the growth and preservation of the nervous substance mainly if not wholly depend. It is in this respect to the parts in question, what the neurilema is to a nerve, or the periosteum to the bones: if a portion of it be peeled off from the surface of one of the hemispheres, the denuded structure will be deprived of its vascular supply, and speedily fall into a state of gangrene. In its texture, this membrane is essentially vascular, the vessels of which it is composed being connected together by the finest cellular substance, which, at the same time penetrates the nervous matter, so as to contribute to its organization. Of the remaining envelopes, nothing need be said here, further than that the one is of a fibrous, the other of a serous nature.

The serous tunic, called, from its excessive tenuity and tenderness, the arachnoid membrane, secretes a thin, limpid fluid, which surrounds the brain and spinal cord, precisely like a sheet of water. The thickness of this aqueous layer is not the same in all parts of its extent. Being from one to two lines on the cerebral hemispheres, it diminishes about the cerebellum, augments at the base of the brain and in the upper part of the neck, decreases again in the back, and finally reaches its maximum in the lumbar region. If an incision be made through the dura mater in the latter situation, the visceral lamella of the arachnoid, from the pressure of the contained water, will protrude across the opening like a hernial bag. None of this fluid naturally exists in the ventricles, or, at any rate, only a very small amount.

The entire quantity of water in the normal state has been estimated at about three ounces. The old have more of it

than the young; and it is also said to be more abundant in women than in men. It is of a clear, limpid aspect, slightly saline in its taste, and nearly uncoagulable by heat, alcohol, and acids. When evacuated, it is speedily regenerated, generally within four and twenty hours. The seat of this liquid is the fine, delicate subarachnoid cellular tissue, — a circumstance which serves, in some degree, to distinguish it from that which is poured out upon the free surface of the serous membrane as an effect of inflammatory irritation.

Although the existence of this fluid was announced, in the last century, by Haller and Cotunni, yet, as it was generally regarded merely as a pathological product, the facts which they communicated concerning it seem to have been entirely overlooked until a few years ago, when the attention of the profession was again awakened to the subject by M. Magendie. In an able memoir* read before the Royal Academy of Medicine, at Paris, in June, 1828, this distinguished physiologist has embodied the results of his observations and experiments, from which it clearly appears, that this secretion, instead of presenting itself merely in the form of a halitus, as it was formerly thought to do, always exists in an appreciable condition. He has designated it by the appropriate name of the *cephalo-spinal liquid*; and he supposes that it exerts an important influence upon the function of the brain and spinal cord, since the sudden loss of it in the inferior animals occasions dulness and immobility, which gradually subside as the water reaccumulates.

The brain and spinal cord are composed of two kinds of matter, one of which is of a white appearance, the other of a pale ash-color. Upon the minute structure of these substances not a little attention has been bestowed; and, although the attempts that have been made for the purpose of unravelling it have not been altogether unproductive of useful results, yet it must be confessed that many interesting points concerning it are still veiled in obscurity. Until within a comparatively recent period, anatomists generally believed that the two forms of matter exhibited the same structure and arrangement, the only difference consisting, as was alleged, in the greater vascularity of the one over the other. The fallacy of this opinion was first shown by Gall and Reil, who have

* This memoir has been ably translated by my friend Dr. Joseph Gardner, of Pennsylvania, and published as an appendage to my edition of Hatin's Manual of Obstetrics. Philadelphia, 1828.

satisfactorily demonstrated the interesting fact, that the white substance is essentially fibrous, and the gray essentially granular. The texture of both appears to be made up of delicate globules, which are united together by a transparent jelly-like matter, the quantity of which, always small, varies in different parts of the cerebro-spinal mass. Their arrangement in the white substance is linear, so as to give it its fibrous appearance ; but, in the gray, they are disposed irregularly, without any assignable order.

The white substance is uninterruptedly continuous in all parts of the nervous system, in which respect it may be said to resemble the cellular tissue, which is uninterruptedly diffused through the whole body. The fibres of which it is composed are, however, much more distinct in some situations than in others, owing either to the fact of their being larger, or, as is not improbable, to the greater laxity of the connecting element. They are made particularly conspicuous by the assistance of such agents as coagulate the albumen which they contain, such as alcohol, dilute nitric acid, a solution of corrosive sublimate, or of alum, and by the action of hot oil of turpentine. In many parts, however, they are sufficiently visible without artificial preparation, particularly at the Varolian bridge, the crura cerebri, the great commissure, and striated bodies,—structures in which they are uncommonly well developed. The recent researches of Ehrenberg and Raspail countenance the opinion of the existence of two distinct sets of fibres in the white substance ; the one being studded with minute knobs, the other, which is the larger, being distinctly tubular, and contained within a granular matter. The first is found in most parts of the encephalo-rachidian mass, as also in the sympathetic cord, the ganglia, and the nerves of the special senses : the latter belongs to the base of the brain, the cerebral crura, the motor nerves of the skull, and the spinal nerves, particularly such as are destined to motion.

The nervous fibres assume two principal directions, the vertical and horizontal. The first are seen in the spinal cord, from which they appear to ascend through the oblong medulla, Varolian bridge, and cerebral crura into the substance of the brain, properly so called. From the cerebral crura they pass along the outer side of the optic thalami, and thence diverge in all directions to reach the convolutions on the surface of the hemispheres. The optic thalami and striated bodies are appendages to this vertical set of fibres, or, in the

language of Gall and Spurzheim, they perform the office of ganglia to them. These fibres, it may now be observed, are seen on the anterior part of the spinal cord, and they appear to constitute the pyramidal and olivary tubercles. Another set, ascending along the posterior portion of the cord, pass through the substance of the restiform bodies. Continuing their course, they form the crura cerebelli; after which, passing outwards, they diverge into the lobes of the cerebellum. Thus both the cerebrum and cerebellum are intimately connected with the medulla oblongata; and, by means of two oblique rods of white matter, technically termed the cerebello-testicular processes, with each other.

The horizontal fibres belong exclusively to the encephalon: they are found only in the callous body and the Varolian bridge, in which they run transversely, or nearly so; in the anterior commissure, in which they are arranged obliquely, and in the fornix, in which they run antero-posteriorly. By this arrangement, the ascending fibres, previously described, are brought into intimate relation with the horizontal, which thus subserve the purpose of so many commissures.

The *granular substance* may be likened, in its mode of distribution, to the adipous tissue, as it occurs only in isolated points, whilst the fibres of the other, as before stated, are every where continuous. Investing the surface of the cerebrum and cerebellum, it occupies the central portion of the spinal cord, and is also found in large quantity in the interior of the striated bodies, optic thalami and quadrigeminal tubercles. It enters, moreover, into the composition of the ganglia, and probably also into that of the nerves; at all events, such is the conclusion I have arrived at from personal inspection, and which coincides with the views of Monro, Gall, and several other distinguished anatomists. Much controversy has existed in relation to the intimate nature of the gray matter; but the idea is now pretty generally entertained, that it consists of a plexus of minute vessels, in the meshes of which is an irregular granular pulp, which assumes a somewhat fibrous arrangement as it approaches its junction with the medullary substance.

Modern chemistry has ascertained that the nervous substance is a peculiar compound, unlike any of the other constituents of the body. Water and albumen appear to be the principal ingredients; it affords, besides, various fatty matters and cholesterine; it also contains sulphur, phosphorus, and a

small amount of osmazome. It is to the presence of albumen that the nervous substance owes its coagulability on being immersed in alcohol, a solution of oxymuriate of mercury, or any of the dilute mineral acids. It is readily decomposed by exposure to a moist atmosphere ; and, when put in water, it is gradually converted into a greenish putrilage, remarkable for its fetid exhalation.

The *consistence* of the cerebro-spinal mass varies not only in different parts of its extent, but at different periods of life, and under different circumstances of health and disease. In regard to the granular and fibrous substances, the latter, it is well known, is always more firm and resisting than the former, which is generally so soft, no matter in what situation it be examined, as to be readily crushed by the slightest pressure. This is particularly true of the granular texture of the cerebellum, the cohesive power of which is invariably less than that of the brain, properly so called. The term pulpy, which was until recently employed to designate this form of nervous matter, is sufficiently expressive of its normal consistence.

The fibrous substance is comparatively firm, and, when recent, even elastic. Broad, thin slices of it, from one to two lines in thickness, generally possess a sufficient degree of tenacity to resist laceration : a keen knife is necessary to divide it, and the cut surface is usually somewhat rough. Exposed to putrifaction, the fibrous substance resists its invasion much longer than the granular, nor does it lose so much of its weight by desiccation. But in pure water it retains its consistence unaltered during a period varying from eight to twelve hours: subsequently it begins to soften, and, in the course of a few days, it is converted into a pulpy, greenish, and offensive mass.

In the cerebrum the white substance is remarkably firm in the great commissure, the annular protuberance, and the ascending crura, — parts, it will be remembered, in which the fibrous structure is unusually distinct and well developed. The interventricular septum, the fornix, and optic thalami, together with some of the other figurate bodies in the lateral cavities of the organ possess very little tenacity, and are frequently so soft, even within the range of health, as to render it difficult to demonstrate them. In the cerebellum, the substance in question is more firm and dense in the diverging crura, and the ascending processes, than in any other situation.

Of the spinal cord, the oblong and cervical portions are the hardest and most resisting.

As was before stated, the consistence of the encephalorachidian mass varies considerably in the different periods of life. In the new-born infant, the component elements are soft and pulpy, like well-boiled pap, mashed turnips, or warm custard: they readily receive the impression of the finger, cannot be easily cut, except with a very sharp scalpel, and are freely impregnated with viscid serosity. By and by they acquire greater firmness and tenacity; the interstitial fluid diminishes in quantity; the line of demarcation between the white and gray substance becomes more conspicuous; the figurate bodies are distinctly mapped out, and the whole mass is now compressible and elastic, but still too soft to bear much handling. At what period the several organs acquire their maximum of consistence, is a point which can only be settled by future observation: judging from my own dissections, I should think this did not occur, in the generality of cases, before the eighteenth year. In old age, the cerebro-spinal axis is commonly remarkably hard and firm, in accordance with a law of the animal economy, by which the organs and textures are drained of their interstitial juices.

Concerning the *color* of the cerebro-spinal mass, not much need be said in this place. In the foetus and new-born infant, the two substances are so nearly alike in their complexion as to render it difficult to distinguish them from each other,—a circumstance which has given rise to the idea, so warmly advocated by Gall, Spurzheim, and Tiedemann, that they are not of simultaneous formation. As life advances, the lines of distinction become more abrupt, and the component elements assume the peculiar hues which characterize them in the adult.

The intensity of color of the granular texture is influenced by a variety of causes, the principal of which are referable to age and health. In early life, it is of a light rosy tint, which is gradually changed into a cineritious complexion. In very old people, I have frequently seen this substance exhibit a drab-colored aspect, probably from the obliteration of some of its capillary vessels, followed by a diminution of blood. In dropsical subjects, and in such as are habitually bled, or exposed to profuse evacuations, of whatever kind, the gray color is much less intense than in such as are healthy; in many cases, indeed, it is nearly lost, the whole cerebro-

spinal mass presenting a remarkably blanched appearance. The fibrous texture is not so clear in children as in adults ; and, in the aged, it is often of a milky white. In protracted jaundice, both substances have repeatedly been found of a light yellowish hue. Several examples of this kind have fallen under my own notice.

We may conclude, from the investigations of Sir Charles Bell, and other physiologists, that the cerebral matter, in its normal condition, is insensible, but that, when it is inflamed, it becomes extremely painful. It has not been determined whether in the latter state the suffering should be referred to the sensibility of the connecting cellular tissue, the distended vessels, or the compressed nervous fibres and granules. These are points which it is difficult to ascertain, and concerning which, in the absence of positive facts, it would be idle to speculate. The spinal cord appears to possess a different kind of sensibility, experiencing, when cut or pricked, the same feeling as a nerve.

The cerebro-spinal axis is amply supplied with blood, more so, undoubtedly, than any of the other parts of the body. The amount of fluid distributed to the encephalon alone has been estimated at about one fifth of the entire circulating mass. This estimate probably exceeds the truth : the quantity is very great in proportion to the size of the organ under consideration ; but, as it does not admit of accurate appreciation, no satisfactory statement can be made respecting it. The arteries engaged in carrying on the cerebral circulation are the vertebral and internal carotid, the first of which enter the base of the cranium at the occipital foramen, the other at the carotid canal in the petrous portion of the temporal bone. Having sent branches of intercommunication, the passage of which is extremely tortuous, they immediately separate into an infinite number of twigs, which penetrate the surface of the brain in the form of capillaries, — an arrangement which is of essential importance, when we consider the excessive delicacy of the nervous substance, and the immense amount of blood pervading it.

The precise arrangement of the arterial capillaries in the cerebral substance, is not known : they traverse the organ in every conceivable direction, and at length terminate in corresponding veins, which, after forming a net-work on the surface of the brain, finally open by eight or ten trunks into the sinuses of the dura mater.

No absorbent vessels have hitherto been detected in the cerebro-spinal axis, notwithstanding the numerous attempts that have been instituted for that purpose. That they exist here, however, as elsewhere, is abundantly proved by what occurs in apoplectic individuals. In cases of this kind, the effused blood undergoes a series of changes which can only be accounted for on the assumption that there are appropriate absorbent agents. The red particles are gradually carried away, and the fibrinous mass, which is at first hard and solid, is finally wrought into a delicate cellular texture, the meshes of which are filled with yellowish serosity.

In dismissing this branch of our subject, it will be necessary to say a few words in relation to the speculation of Kellie, Abercrombie, Clutterbuck, and others, that the encephalon uniformly contains the same amount of blood, no matter what may be the quantity of this fluid in other parts of the body, whether normal, increased, or diminished. The proposition of these pathologists is founded on the assumption that the organ in question is not only incompressible but wholly removed from the influence of the atmosphere, and that it always accurately fills the cranial cavity. From these physical conditions, it follows, they allege, that no material variation can take place, within a short time, in regard to the absolute quantity of blood in the brain; or, what is the same thing, that there can be no actual plethora or anemia; and hence venesection, to whatever extent it be carried, can affect the cerebral circulation only secondarily, indirectly, or consecutively, that is to say, only by lessening the force of the heart. Granting that the encephalic mass is entirely incompressible, as its very composition, indeed, abundantly proves, the idea that it accurately fills the cavity of the skull, and is completely protected from the pressure of the atmosphere, is, I presume, a mere assumption, and susceptible of easy refutation.

That there is a vacuity between the skull and the surface of the brain, or, in other words, that these parts do not lie in actual and close contact, is a fact with which every one is familiar. During health, when the circulation is in full activity, this space is small; but, in certain pathological states, as well as after death, it is often quite considerable, and admits of ready demonstration. But for its existence, no effusions could take place into the arachnoid sac on the surface of the cerebral hemispheres, the ventricular cavities, or at the base

of the cranium ; unfortunately, however, this is not the case ; for not only are such effusions very common, but they frequently exist to a very great extent. Add to this that the brain is in a state of constant locomotion, and there can be no difficulty in forming a correct conception of the vacuity under consideration. This movement is very apparent at the fontanelle of the infant, and is often seen in injuries of the skull, attended with a loss of osseous substance : it is connected with respiration, and is characterized by a distinct rising and falling of the encephalic mass, produced, probably, by atmospheric pressure.

But it is alleged, secondly, that the brain is completely withdrawn from the pressure of the atmosphere. This view is only partially correct. There is, we admit, no pressure exerted above and at the sides of the cranium, but there certainly is below ; so that, in this respect, the brain is circumstanced pretty much as the thoracic and abdominal viscera, which are subjected to the influence of the atmosphere only in certain directions, not in all.

Thirdly, the experiments performed by Dr. Kellie, with the hope of illustrating this subject, are any thing but conclusive. The turgescent state of the cerebral vessels observed by this physician in animals after being bled to death I have often noticed myself ; but it is by no means, as he supposes, peculiar to the encephalic mass. The other internal organs usually participate in the plethora, which is sometimes so great that the blood will escape in considerable quantity upon the slightest pressure. This is especially true of the liver, spleen, lung, and kidney. In these structures, as I have frequently had occasion to observe at our slaughter-houses, the vessels are as well filled as those of the brain ; sometimes, indeed, much more so.

Nor is it generally true, as has been affirmed by Kellie and Monro, that, after strangulation, the vessels of the brain retain their normal appearance. Every one knows that, in the majority of instances, the reverse is the case. In twelve experiments, which I performed some years ago, on manual strangulation, the cerebral capillaries were every where deeply injected, the larger sinuses distended, and the vessels of the pia mater completely engorged. The subjects were dogs and rabbits ; and the hand was applied directly over the carotid arteries and jugular veins, until the animals ceased to breathe, — a circumstance which fully accounts for the plethoric condi-

tion of the encephalic mass. In none of the cases was there any extravasation of blood.* Similar effects are produced in strangulation from suspension, excepting where the cord happens to be so placed as not to interfere materially with the return of the blood from the head to the heart.

But, independently of these facts, of the truth of which any one may easily satisfy himself, daily observation fully disproves the conjectures of the British pathologists. In protracted abstinence, the brain invariably partakes of the general deficiency of sanguineous fluid, becoming abnormally pale, and otherwise altered ; and similar phenomena are often witnessed in anemia, whether produced by innutritious diet, starvation, or lingering disease. In such cases, dissection rarely reveals any serous effusion. Analogous effects are frequently caused by excessive bleeding. Every practitioner must have met with instances of this kind. A most interesting one came under my notice several months ago. A gentleman, forty-four years old, was seized with symptoms strongly denoting cerebral apoplexy, for which he was bled, at different operations, to the amount of nearly six pounds, before his pulse began to flag. Under this treatment, assisted by purgatives, and external irritants, his sensibilities were to a certain degree restored, and in about thirty-six hours he began to speak. In a short time, however, his mind became greatly excited, and at intervals he raved under the most furious delirium. Finally, convulsions set in ; and, after repeated attacks of this kind, he fell into a comatose condition, and expired on the fourth day of his illness. On examination, I found all the internal viscera in a state of complete anemia, excepting the spleen, which was somewhat engorged as the effect of previous irritation. The brain, which was supposed to be the chief seat of the disease, was remarkably blanched, and every capillary appeared to have been drained of blood : the vessels of the pia mater were empty, and the larger sinuses contained only a few drops of thin claret-looking fluid. A small quantity of serum, altogether not exceeding two ounces, existed in the ventricles and at the base of the brain.†

From the foregoing facts, and the reasoning founded on

* See the author's paper on Manual Strangulation in *Western Journal of the Medical and Physical Sciences*, vol. ix. p. 25.

† *Western Journal of the Medical and Physical Sciences*, No. liv. p. 513.

them, we are fully warranted, I think, in concluding that, although the brain itself is really incompressible, and in some degree beyond the influence of atmospheric pressure, yet, notwithstanding all this, the amount of blood sent to it is liable to the same variation as in other parts of the system, and that it may consequently be diminished in the same ratio by bleeding, low diet, and other depletory measures. If this deduction be true, as there is just grounds to believe it is, the conjecture of Abercrombie and Clutterbuck, that we cannot lessen the quantity of blood in the head, in any material degree, by our evacuations, resolves itself into a “baseless fabric,” void even of the shadow of proof.

The preceding sketch of the organization of the nervous texture would be incomplete without adding a few remarks on the *weight* of the encephalon and the *form* of the spinal cord. It need scarcely be stated that the size of the cerebrum and cerebellum is always in direct ratio to the magnitude of the bony case which encloses them. The mean weight of these masses has not yet been determined, nor is this a matter which, in a pathological point of view, is of much moment, since it is generally very easy, for one accustomed to making examinations, to discern the boundary which separates the normal from the abnormal state. In six adult brains, I found the mean weight of the cerebrum to be two pounds, five ounces,—the minimum three ounces less, and the maximum four more. In the same cases, the average weight of the cerebellum was six ounces, the minimum four ounces and a half, and the maximum eight ounces. The annular protuberance, placed between the cerebrum, cerebellum, and oblong portion of the spinal cord, forms about the sixtieth part of the central mass. In the foetus and child, the cerebellum is proportionably larger than subsequently; and the same holds good in regard to the encephalon as compared with the rest of the body.

In the adult, the spinal cord extends from the inferior border of the Varolian bridge as far as the level of the first lumbar vertebra. Occasionally, it reaches a little lower down; and, in one instance, Keuffel saw it end opposite the eleventh bone of the back. Its length may thus be said to vary from sixteen to twenty inches, according to the stature of the subject. In its general outline, the cord is nearly cylindrical, its tranverse diameter, however, being somewhat greater than the antero-posterior, which gives it rather a flattened appear-

ance in the former direction. Its thickness, which is scarcely half an inch, is not uniform, from one extremity to the other. Three distinct swellings are observable in different parts of its extent. Inferiorly, it is enlarged just before it terminates, in the caudal prolongation: the second expansion corresponds with the interval between the third and sixth cervical vertebræ; and the third forms what is termed the oblong medulla, which is properly only the commencement of the cord.

The cranial portion of the cord, usually called the oblong medulla, is of a flattened cylindrical form, being broad and thick, superiorly, near the Varolian bridge, but tapering gradually towards the occipital foramen. Two longitudinal grooves, continuous with those of the cord below, and situated, the one on its anterior, the other on its posterior aspect, divide this swelling into two symmetrical parts, each of which consists of three distinct nodules, namely, the anterior pyramid, the olivary tubercle, and the restiform body. A transverse section of these prominences shows them to be composed of granular matter, invested by a thin lamella of white substance, the fibres of which pass the two median grooves obliquely, and so a decussation is produced between them. This intercrossing, which is very perceptible at the lower portion of the oblong medulla, enables us to account for the singular fact — at one time altogether inexplicable — why a lesion of one side of the encephalon leads to paralysis and loss of sensation of the opposite side of the body.

SECTION II.

Of the Cerebral Envelopes.

I. THE dura mater is susceptible of *inflammation*. The disease generally occurs in irregular circumscribed patches of greater or less size, and but rarely exists, excepting as a consequence of external injury. When thus affected, many extremely fine vessels, filled with florid blood, are seen in the dura mater, running in beautiful arborescent lines. Often the redness exhibits a peculiar bluish tint, not unlike what we see in scleritis; and, although the injection is sometimes remarkably great, yet the inflamed portion is never so much

crowded with capillaries as other membranes are which are naturally more vascular. In most cases, the inner surface of the dura mater is covered with small masses of lymph ; and, not unfrequently, it is lined by a tolerably thick, adventitious membrane. In this manner, extensive adhesions may be produced between it and the other tunics, or even between it and the convoluted surface of the brain.

Suppuration of the dura mater is seldom, perhaps never, met with, excepting as a consequence of external violence. The matter is commonly deposited upon the inner surface ; but instances have been witnessed in which it was found between its layers, or upon its outer surface. In the latter case, when the fluid is considerable, long retained, or of an acrid quality, it may erode the membrane and escape into the arachnoid sac. Occasionally, too, it produces caries and perforation of the cranial bones ; but such occurrences must be extremely infrequent.

Various are the morbid changes which result from *chronic inflammation* of the dura mater. Of these, the most important, however, are thickening fibrous growths and ossification. The thickening, which is almost always conjoined with induration, varies extremely in degree, and is sometimes so great as to occasion symptoms of cerebral pressure. Bonetus mentions an instance where it was nearly half an inch ; and similar examples are recorded by others. It is sometimes found in fatal cases of epilepsy, and paralysis. In one instance which fell under my notice not long since, the thickening was connected with caries of the frontal bone, the membrane presenting a very rough, fungous appearance. The reverse of this state is sometimes observed, the dura mater being remarkably thin and attenuated.

Fibrous tumors, of the size of a small nut, sometimes grow from the dura mater, generally from its inner surface, to which they either adhere by a narrow foot-stalk, or, as sometimes is the case, by a broad base. They are of a grayish color, of a dense, fibrous texture, hard, inelastic, and seldom acquire any great bulk.

One of the most common morbid appearances of the dura mater, as has been justly observed by Dr. Baillie, is the formation of thin plates of *bone*. These I have very frequently observed, and am inclined to regard them as originating rather in the subserous cellular tissue, than in the substance of the membrane itself. They are most commonly noticed

in the great falciform process, where they occur in small, irregular masses, not larger than a finger-nail. In several instances, however, I have seen them of the size of a Spanish dollar; and cases are given, in which the ossification occupies nearly the whole of the dura mater of one hemisphere. These bony plates are generally very hard, of a yellowish color, more or less rough on the surface, and, when sawed, they occasionally exhibit a real porous structure, like the osseous tissue in other parts of the body.

Various other kinds of morbid growths and depositions are described by authors, as being occasionally found in the dura mater; but their occurrence is so extremely rare, and their nature so little understood, that it is not worth while to give any account of them in this place.

The *Pacchionian glands* are occasionally much enlarged, indurated, and changed to the appearance of grumous blood. The *sinuses* of the dura mater are also sometimes diseased. The most frequent affection, by far, is inflammation of their lining membrane. When thus affected, the serous tunic is unnaturally vascular, opaque, covered with lymph, slightly thickened, and occasionally even ulcerated. Ribes and Tonnelé, tell us that they have sometimes seen the sinuses partially filled with pus; and nothing is more common than to find them obstructed with firm, dense, fibrinous concretions.

II. *Arachnitis* being a disease of very frequent occurrence, it will be necessary to dwell upon it at some length. The most important anatomical characters are increase of color, opacity, thickening, and supernatural firmness, with effusion of serum, lymph, pus, and sometimes even of blood. In the early stage of the disease, the membrane does not present any perceptible alteration, but remains thin and transparent as in the normal state; and, what is remarkable, the pia mater is almost always affected first, being usually thickened and deeply injected, long before any change can be recognized in the arachnoid itself.

All parts of the arachnoid do not seem to be equally susceptible of inflammation. The portions most frequently implicated are those in the ventricles of the brain, on the convexity of the hemispheres, at the base of the cerebellum, the junction of the optic nerves, the Varolian bridge, and, lastly, at the internal flat surface of the hemispheres. Such, at least, is the result of my own observations corroborated by that of some of the most distinguished pathologists of the age.

The redness of the arachnoid is usually limited in its extent, being restricted to a few points on the convexity of one or both hemispheres, at the base of the brain, or between the lobes of the cerebellum. Occasionally, when the inflammation is very intense, the redness occurs in pretty large patches, and appears to be caused by a real extravasation of blood ; but, even under these circumstances, it is quite impossible to trace any vessels into the affected membrane ; and hence I am inclined to think that Dr. Hope, and others who have delineated such vessels, are in error,—believing that they belong rather to the pia mater and the connecting cellular tissue than to the arachnoid itself. What strengthens this opinion is, that the color may frequently be removed by scraping the part with a scalpel, or exposing it for a few minutes to a gentle current of water ; which could not be effected, did it exist in the substance of the membrane.

With this augmented vascularity, if such it may be styled, is usually conjoined, at an early period of the disease, a loss of the natural transparency. At first there is merely a slight degree of opacity, scarcely appreciable without the closest examination ; but, by degrees, the membrane assumes a whitish, milky aspect, interspersed, not unfrequently, with shining pearly specks, and small patches of red. Cases are recorded in which the arachnoid is said to have exhibited a dark mottled appearance ; but of this I have never seen an instance.

After the disease has existed for some length of time, especially if it have been very violent, the membrane is found to have a real increase both of thickness and of density, so that it may be easily detached from the surface of the brain, and even from the dura mater. These changes, although they sometimes occupy a considerable extent of surface, usually occur in small patches, which are confined to some parts of the upper surface of the hemispheres, the cerebellum, or base of the cerebrum. In cases of this kind, the pia mater is not only deeply injected, but the cellular tissue between it and the arachnoid is infiltrated with various kinds of fluids, such as serum, lymph, blood, and occasionally even with pus. These substances may all be witnessed at the same time ; but, in the generality of instances, the first two alone are met with. Occasionally, the subarachnoid tissue is emphysematous,—from what cause it is unknown.

The effusion of serum is sometimes very copious ; and, in

parts where the subarachnoid cellular tissue is very loose and abundant, as, for example, in the intergyral spaces, at the fissure of Sylvius, the Varolian bridge, and the junction of the optic nerves, the distention is occasionally so great as to raise the membrane up in the form of considerable vesicles, of a gelatinous appearance. In quantity, it may vary from a few drachms to several ounces, being always more copious in the ventricles than on the surface or base of the brain. In its appearance, it is usually limpid, but now and then opaque and milky, from the admixture of lymph. When the inflammation is very severe, we sometimes meet with depositions of pure blood, either in the subarachnoid cellular tissue, in the substance of the pia mater, or in the intergyral spaces. The presence of puriform fluid is always indicative of high vascular excitement, and frequently attends wounds, contusions, and other lesions of the head. Dryness of the arachnoid is occasionally observed, generally in small patches, of a hard, shriveled aspect. Their presence always denotes excessive cerebral irritation.

The deposition of lymph is much less frequent upon the surface of the arachnoid than upon that of the pleura or peritonæum. That it is very often met with, however, every anatomist, who is at all in the habit of making necroscopic examinations, must be fully aware. Nor is the effusion of lymph always confined to the free surface of the membrane. In the majority of cases, indeed, it occurs in the subjacent cellular tissue, where it is frequently seen of great extent, communicating a yellowish tint, to a large portion of the hemispheres. In some instances, it follows the course of the pia mater, producing adhesion between the convolutions, and filling up the intervals between them: occasionally, though rarely, it is witnessed in the ventricles, covering the choroid plexus; and a very common seat of it, according to Abercrombie, is the superior surface of the tentorium. In its color, this deposit is generally more or less opaline, with various shades of green and yellow.

When occurring upon the free surface of the arachnoid, the lymph is often moulded into a distinct membrane, the thickness, color, and consistence of which, are much influenced by the length of time it may have existed, no less than by the violence and extent of the inflammation. In a stout athletic man, thirty-five years of age, who died from acute meningitis, brought on by a most extensive fracture of the skull, the

exudation, which covered the greater part of the right hemisphere, was about the thickness of a common wafer, of a pale straw-color, inclining to greenish, and of the consistence of the buffy coat of the blood, before it has undergone perfect coagulation. The rapidity with which this deposition may take place is strikingly exemplified in the case before us, in which the patient expired in less than three days from the occurrence of the accident. In instances of long standing, the color is usually lighter, the consistence more firm, and the thickness greater. I have never seen these adventitious membranes organized; but Dr. Hooper has delineated one which is beautifully transparent, and abundantly supplied with vessels from the dura mater.

Such are the principal anatomical features of acute arachnitis. In the chronic form of the disease, the alterations are still more varied, consisting of greater thickening and opacity of the arachnoid and pia mater, increase of firmness and tenacity, organized adventitious membranes, tubercles, cartilaginous and osseous concretions, and, in some cases, of copious effusions of serum,—giving rise to the disease named *hydrocephalus*. In acute arachnitis, as has been stated, the quantity of serum seldom exceeds two or three ounces; in chronic, on the contrary, it is always very considerable. I have myself, in several instances, removed nearly two pints of fluid; and cases are narrated in which the amount was much greater. Thus, Dr. Horner mentions an instance in which the lateral ventricles alone contained five pints; and Fabricius Hildanus gives another, in which the quantity was upwards of two gallons. Chronic hydrocephalus not unfrequently exists as an intra-uterine affection; more commonly, however, it makes its appearance soon after birth, and goes on progressing until the head attains an enormous development, out of all proportion to the rest of the body.

The fluid of hydrocephalus is generally perfectly clear and limpid, possessing, indeed, very much the same qualities as the serum of the blood, from which it is derived. In most cases, it is without smell and without taste, though the latter is sometimes slightly saline; and, by exposure to heat, I have, in several instances, found it as perfectly coagulable as the water of ascites, hydro-thorax, or hydrocele. It should be stated here, however, as a general proposition, that the quantity of albumen is much less than in peritonæal and other serous effusions; and hence heat, alcohol, and acids seldom exert upon it the same marked effect.

The specific gravity of this fluid, according to Dr. Trail, of Liverpool, is a little greater than that of common water, in the proportion of about a twentieth part. The best analysis that we have of it is by Dr. Marct, who found the solid contents of one thousand grains of the fluid of the ventricles to consist of,—

Water,	990.80
Muco-extractive matter, with a vestige of albumen,	1.12
Muriate of soda,	6.64
Sub-carbonate of soda, with a vestige of an alkaline sulphate,	1.24
Phosphate of lime, with traces of phosphate of magnesia and iron, . . . . .	.20
	<hr/>
	1000.00

The fluid of congenital hydrocephalus has been recently analyzed, with great care, by Dr. B. G. Babington, of London, who states its specific gravity to be 1004. It does not coagulate by heat, alcohol, or acids, and consequently does not contain, as he supposes, albumen. Instead of this substance, he detected a very minute quantity of gelatine.

Chronic hydrocephalus is usually connected with softening of the cerebral tissue, which is not unfrequently quite pulpy and reticular. The parts most commonly affected are the great commissure, fornix, and interventricular septum. In young children, who are mostly the subjects of this accumulation, the bones of the skull are often widely separated, the brain unfolded, and the whole head remarkably distorted. In a case which I recently examined, a considerable number of minute apoplectic effusions were discovered, for the most part in the right crus cerebri, just in front of the Varolian bridge, where there were as many as ten or a dozen.

The ventricles of the brain are variously affected. When the quantity of fluid is considerable, they are expanded into large sacs, frequently lined by a thin layer of lymph, into which vessels may be seen dipping from the subjacent parts. In such cases, the figurate bodies of the brain are sometimes wholly destroyed, the convolutions effaced, and the gray substance compressed, as it were, into a thin shell, occasionally not more than half a line in thickness.

Not unfrequently, the free surface of the arachnoïd is roughened with minute *tubercles*, varying from the size of a clover-seed to a common currant. Their most usual situation is the lateral ventricle, the fissure of Sylvius, and the interval

between the lobes of the cerebellum. No part of the membrane, however, seems to be exempt from them. These little bodies, which are generally of a whitish, semi-transparent appearance, are of an irregularly rounded shape, and of a dense, fibro-cartilaginous consistence: oftentimes, they occur in thick clusters, and are surrounded by a yellow, concrete substance, the intervening portions of membrane being opaque and milky. Tubercles of the arachnoid almost always co-exist with tubercles of the lungs or of some of the other organs: they are seldom met with in adults, but are sufficiently common in children under three years of age.

Arachnitis presents three stages, each of them characterized by a distinct group of symptoms. The first comprises the period of cerebral excitement, and is marked by increased sensibility to all sorts of impressions, with irritability of temper, headache, flushed cheeks, grinding of the teeth, knitting of the eyebrows, wakefulness, a quick, jerky pulse, and irregularity of the bowels.

In the second stage, which constitutes the period of reaction, or, more properly speaking, that in which the cerebral irritation is propagated to the muscular and nervous systems, the diagnostic characters are, great restlessness, agitation, and convulsions; torpor of the bowels, nausea and vomiting, particularly on assuming the erect posture; intense headache, loss of memory, altered pronunciation, intolerance of light and sound, with quick pulse, hurried respiration, a circumscribed flush on one cheek, and general fever. The convulsions are commonly long and severe; and it is not undeserving of notice, that, when the arachnitis is seated on the convex surface of the cerebral hemispheres, delirium sets in very early, and becomes the prominent and characteristic symptom; whereas, if it occur at the under surface and base of the brain, coma is the more usual attendant. The duration of this stage varies, from a few days to a week or more.

The third stage, which is that of collapse, is marked by immobility of the pupils, loss of sensation, more or less hemiplegy, strabismus, paralysis of one or both eyelids, constant somnolency, oblivious state of the intellect, and convulsive twitchings of the muscles of the face, the trunk, or extremities. The third stage lasts from a few hours to three or four days.

The symptoms of chronic arachnitis, at the commencement, are generally not very well marked; they all, however, par-

take of the character of those mentioned as indicating the acute variety of the disease. Usually, the patient experiences some difficulty in articulating words; he is forgetful, his ideas are incoherent, and his whole gait is unsteady and vacillating; the limbs are frequently agitated with convulsive tremors; and the intellectual disturbance, although slight at first, is regularly progressive, until at length it terminates in confirmed idiocy. Delirium and progressive paralysis are, according to Bayle, the constant attendants on chronic arachnitis.

III. The *pia mater*, on the whole, is not often diseased. In arachnitis, it is not unusual to see its substance inflamed, and its vascularity greatly augmented, with small masses of lymph adhering to its surfaces, especially the outer. Under these circumstances, the vessels of the *pia mater* are unnaturally conspicuous, are filled with florid blood, and form, by their anastomoses, a beautiful net-work. Most generally, this augmented vascularity occurs in considerable large patches, which are often of a bright red color, and easily detached from the convolutions of the brain. Small sanguineous effusions are occasionally observed; and, in some instances, the part presents an ecchymosed or blood-shot aspect. When the *pia mater* is inflamed to a high degree, pus is commonly formed, which sometimes spreads over the whole upper surface of the brain, or finally erodes the membrane, and gets in contact with the cerebral tissue. Ulceration, however, and mortification are rare consequences of inflammation of the *pia mater*.

Tubercles are sometimes seen growing from the surfaces of the *pia mater*. They have been found as big as an egg, though usually they are not larger than hazelnuts; are of a yellowish color, of a spherical shape, and break down ultimately into a puriform fluid, forming circumscribed abscesses on the surface of the brain. Occasionally they exhibit a cartilaginous texture, and are enclosed by a delicate vascular cyst.

Ossification of the *pia mater* is very uncommon. Dr. Baillie never saw an instance of it; but states that the celebrated Soemmering, who has published a German translation of his Treatise on Morbid Anatomy, with many excellent notes, has a specimen of this disease preserved in his collection. Dr. Hooper has also seen an example of it, in the form of a small bifid mass, not larger than a split pea, which grew

from the internal surface of the membrane, and dipped down into the medullary substance of the cerebrum.

Fungous, bloody, and encysted tumors are sometimes found in the pia mater, or between it and the arachnoid. Dr. Esquirol, of Paris, once met with an encysted tumor of the pia mater containing fat; and similar cases have been recorded by other writers. All these diseased appearances, however, are extremely rare, and it has never occurred to me to observe them.

Diseased appearances are often noticed in the *lateral ventricles*, and especially in the choroid plexus. As a consequence of inflammation, the lining membranes are sometimes very much thickened and indurated, their vessels gorged with blood, and their free surface covered with patches of lymph, occasionally of considerable thickness and density. In the choroid plexus, the most common appearances are *serous cysts*, formed by a very delicate, vascular, and transparent membrane, filled with a clear, limpid fluid. I have never seen them very large, though occasionally they attain a considerable bulk. Their number is often very great. In an old man, seventy-five years of age, ten or a dozen of them were clustered upon the right choroid plexus, the largest of which scarcely equalled a common cherry. Instances are recorded in which as many as a hundred of them were seen in the same individual.

The ventricles of the brain occasionally, although I believe very seldom, contain *hydatids*; and there is reason to believe that the serous cysts which I have just described are frequently mistaken for them. The two varieties which have hitherto been observed are the headless and bladder-tailed; of the latter of which, five species have been seen by different pathologists in the choroid plexus. The vessels of the choroid plexus, it may be here stated, are sometimes greatly enlarged, tortuous, and almost varicose.

SECTION III.

Of the Brain.

VARIOUS experiments have been instituted by pathological anatomists, with a view of ascertaining whether wounds of the brain and spinal marrow are susceptible of cicatrization; but with so little success that the knowledge which has been thus obtained is comparatively unimportant. The cause of this is to be found chiefly in the fact that the animals, the subjects of the experiments, almost always die at an early period after the operation, from the effects of acute encephalitis, thus allowing the parts no chance for healing. If life be preserved for a few days, the edges of the wound are found to be greatly injected with blood, of a deep rose color, and considerably augmented in density, the induration often extending to the distance of three or four lines into the surrounding tissue. With these changes is usually seen a small quantity of soft, reddish lymph, which is smeared over the incised parts, and serves as the basis of the future granulations, which always spring up, if the animal survive the operation a week or fortnight. Not unfrequently, the cerebral tissue, instead of growing hard and firm, acquires an unusual degree of softness, from the infiltration of serosity, pus, or blood, or from the influence of all these fluids united. In other cases, these two characters are combined, the edges of the lesion being dense and indurated, whilst the parts immediately around them are soft, boggy, and permeated with liquids.

Appearances of scars, sometimes of very large size, are not unfrequently found in the brain after death, for which physicians found it extremely difficult to account; that they are formed, however, by the same sort of mechanism as in the other textures of the body, is by no means improbable. Thus, when, for example, the cerebral substance is lacerated by an effusion of blood, the fluid, as will subsequently be shown, occasionally becomes organized and incased in a distinct cyst, which either remains during the life of the individual; or, what is more generally the case, perhaps, when the extravasation is not very copious, it is acted upon by the absorbents, by whose influence it is gradually destroyed, or reduced to a

dense, fibrous texture. When this has been accomplished, there is generally to be found a true linear cicatrix, of a light citron color, and much harder than the cerebral substance, although softer than the scars which we find in most of the other tissues. These cicatrices have, in the majority of cases, a laminated arrangement, with a thickness from the third of a line to the eighth of an inch or more. Yet, not unfrequently, they are perfectly cellular, moist, vascular, and filled with serous fluid.

The brain is subject to various forms of disease, amongst which acute and chronic inflammation, suppuration, softening, ulceration, sanguineous effusions, and new growths, are the most common and important.

Encephalitis, cerebritis, or inflammation of the brain, seldom exists as a primary, idiopathic, or uncomplicated affection: most commonly it is the result of previous disease, as fevers, especially such as are of an eruptive nature, apoplectic effusions, tumors, and external injury. When produced by violence inflicted on the scalp and cranial bones, the inflammation is generally limited in extent, although intense in degree. Never does it involve the whole organ at once; for such a condition would, it is reasonable to infer, be incompatible with the continuance of life. The disease may occur at all ages, and in all parts of the encephalic mass, though some are more obnoxious to it than others.

The anatomical characters of the inflamed structure vary according to the duration and intensity of the disease. At first, there is merely a slight increase of vascularity, with a reddish rose-colored state of the cerebral substance. When sliced with a sharp knife, it presents a multitude of small red points, which give the section the appearance as if it were strewed with particles of vermillion. The capillaries are every where greatly injected; and so firmly is the blood crowded into them, that it is with difficulty removed by ablation. Not unfrequently small ecchymoses are met with, caused by a rupture, no doubt, of minute vessels, in consequence of the violence of the inflammatory action. The extravasation oftentimes occurs in distinct spots, but occasionally it presents itself in irregular lines or streaks, which, when numerous, give the cerebral substance a singularly mottled aspect, with various tints of red, the color being usually more florid in the cortical than in the fibrous texture.

At this early period of the inflammation, there seems to be no distinct line of demarcation between the sound and dis-

eased parts : in most cases they run insensibly into each other, the redness gradually declining in intensity as we proceed from the centre of the irritation towards the periphery ; and, although the affected structure is less tenacious than in the healthy state of the brain, it is firmer than usual, from the turgescence, apparently, of its vessels.

As the disease advances, the vascular injection becomes more and more strongly marked, and the reddish color which was displayed in the earlier stage, gradually deepens, until it acquires a brownish, claret, purple, and occasionally even a greenish or dusky yellowish shade. With this augmented capillary turgescence, amounting almost to complete obstruction, the part becomes preternaturally soft, and assumes that peculiar alteration of character, which has been described by Rostan, Lallemand, and other pathologists, under the name of cerebral mollescence.

The substance of the brain, when thus affected, has entirely lost its natural properties : it has a humid, macerated appearance, from the infiltration of serosity, purulent matter, or blood, and is often converted into a soft, grayish pulp, bounded by a hard, vascular border, exhibiting all the signs of the first stage of inflammation. Several such disorganized spots are sometimes met with, either in close proximity, or separated by considerable intervals. When the affected structure is pervaded by numerous globules of pus, it is very apt to have a citron hue, and then constitutes what Andral has termed the *yellow softening* of the brain ; from which the *red softening*, another variety which he has proposed, differs only in being of a deeper color, the broken down pulp varying from a florid to a claret tint, with intermediate shades of violet, brown, chestnut, or cineritious.

The different appearances now described are not unfrequently met with in the same diseased portion. Thus, we may have the reddened, indurated state at the circumference ; next, that of serous infiltration ; and, finally, that of purulent softening in the centre. The pus always occurs here, as elsewhere, at first in disseminated globules, and afterwards, if the patient survive long enough, in distinct foci. The red and yellow softening are frequently combined, one portion of the inflamed structure presenting the bloody, the other the purulent infiltration.

It has been already stated that the affected part, in the early stage of encephalitis, is, in the generality of cases,

somewhat harder than it is in the normal condition. The degree of consistence is subject to remarkable variations, running through all the intermediate grades, from an indurated, firm, and elastic body to one of almost perfect fluidity. The softened mass, in such cases, is generally surrounded by the hardened, which itself is intimately, and, for the most part, insensibly blended with the healthy cerebral tissue.

In the early stages of encephalitis, as was before intimated, the red color of the inflamed part cannot be removed by ablution, nor can the engorged vessels be filled with minute injecting matter, — thus presenting a striking analogy with what takes place under similar circumstances in the serous and mucous membranes, as well as in the liver, spleen, and kidney.

The vascular and serous envelopes of the brain, are not unfrequently affected in this disease. When the cerebritis is located superficially, the inflamed portions always adhere to these tunics with unnatural firmness, especially in the early stages of the complaint ; and hence, in attempting to peal them off, fragments of cerebral substance, traversed by red and distended capillaries, generally follow. The vessels of the pia mater, under these circumstances, are commonly much engorged ; the arachnoid is opaque and adherent ; and the intergyral hollows are filled with sero-albuminous matter, with blood, or even with pus.

From this rapid sketch of the anatomical characters of acute cerebritis, it will be perceived, that the first effects of the disease consist simply in capillary engorgement, in punctuated or striated redness, which is usually more conspicuous in the cortical than in the fibrous texture, and in increased hardness, varying in degree according to the intensity of the disorder ; and, secondly, that if the inflammation be allowed to go on unrestrained, it finally passes into mollescence, in which purulent, bloody, and cerebral matter, are in general intimately blended together, forming a mass of a semi-liquid consistence, and of a light brownish color, with various shades of yellowish, grayish, claret, or even greenish.

Although all parts of the brain are liable to acute cerebritis, yet there are some which are much more frequently affected than others. The most common seat, seems to be the cineritious texture, the great vascularity of which strongly predisposes it to inflammation and its consequences. Thus, of forty-six cases of this disease, collected by Lallemand, the

gray substance was the principal seat of the inflammation in thirty-three, and the white in only eight. The surface of the convolutions, which consist entirely of cortical matter, was affected in sixteen cases; the striated bodies and optic couches, in which the same substance predominates, in thirteen; and the Varolian bridge, which is made up chiefly of fibrous matter, only in four. Some influence must, also, no doubt, be allowed to the greater extent of surface of the gray substance, and to its intimate connection with the pia mater, which can seldom be much inflamed without the disease being propagated to the contiguous parts of the brain.

Acute encephalitis usually reaches its full height within three or four days from its invasion. When partial, the patient often recovers; but should it occupy a large extent of surface, it generally proves fatal in a very short time, not unfrequently, indeed, in thirty-six or forty-eight hours. The early symptoms are violent headache, intolerance of light, delirium, and acuteness of all the senses, rapidly followed by convulsions, contractions of the limbs, profound coma, and death.

Several writers have attempted to account for the various phenomena which arise during the existence of cerebritis, by a reference to lesions of particular parts of the encephalic mass. Thus, Dr. Martinet supposes,* that affections of the superior extremity are attributable to disease of the posterior fibres of the optic thalamus of the opposite side of the brain; those of the inferior extremity to alterations of the anterior half of the striated body. Paralysis of both sides of the body, existing at the same time, depends upon disease of the central part of the Varolian bridge; loss of speech, on the anterior lobes of the cerebrum; deep and progressive coma, with entire absence of palsy and muscular rigidity, upon the great commissure, fornix, or interventricular septum. When the quadrigeminal tubercles of one side are inflamed, there will be squinting and rolling of the eye, with dilatation and immobility of the pupil of the other; if, on the contrary, the disease affect both sides at the same time, the phenomena just mentioned will usually be present in both eyes.

Lesions of the pituitary gland, and cineritious tubercle at the base of the brain, by causing compression of the optic nerve of one side behind the point of decussation, may induce

* Manual of Pathology, p. 139.

blindness of the opposite eye; whilst derangement of the respiratory, circulatory, and genital organs, without paralysis of the extremities, indicate inflammation or other disease of one or both of the lobes of the cerebellum. Lesion of the crura cerebri is followed by the same paralytic symptoms as that of the optic thalamus and striated body, which are prolonged from it. Disease of the medulla oblongata produces all the phenomena which arise from the joint affection of the cerebellum and cerebral crura; and, if we ascend still higher in the brain, from that also of the striated bodies, optic thalami, and cerebral hemispheres.*

Inflammation of the brain not unfrequently passes into *suppuration*, the matter occurring either in the form of small yellowish globules, or in that of abscesses. The most common seat of the disease is in the anterior half of the cerebral hemispheres, on a level with the great commissure: no portion, however, of the cerebro-spinal axis appears to be exempt from it, cases of it being mentioned by various writers as having been found in the cerebellum, posterior lobes of the cerebrum, spinal cord, medulla oblongata, Varolian bridge, and even the quadrigeminal tubercles and pineal gland.

Collections of purulent fluid present themselves under several varieties of form. In one, which may be denominated the *undefined abscess*, the matter is contained in a cavity, the walls of which are formed by the surrounding brain, and partly, perhaps, by its membranes, if it be seated superficially or near the ventricles. The inner surface of the abscess, though occasionally smooth and even, is generally rough, granulated, and shaggy, the purulent fluid adhering to it with various degrees of tenacity. The cerebral tissue immediately around the cavity is usually remarkably sound; seldom is there any sign of inflammation, induration, or softening. The size of these collections is variable. Not unfrequently, they are as large as a walnut; but, for the most part, they do not exceed the volume of a pea, a grape, or an almond. Occasionally, a whole hemisphere almost is converted into a soft, purulent mass.

The second variety of abscess is the *encysted*. The pus in this species, as the name indicates, is contained in a distinct capsule, formed by the deposition of plastic lymph. The capsule, at first, is soft, delicate, and easily torn: in

* Foville, in Dict. de Méd. et de Chir. Pratique, art. *Encéphale*.

time it becomes dense, remarkably firm, and completely organized, — vessels in great numbers ramifying through it from the circumjacent cerebral tissue. The outer surface of the sac at this stage is rough and flocculent ; the internal is smooth, of a rose-color, and somewhat villous, like the mucous coat of the stomach. Its thickness rarely exceeds that of the pericardium ; but instances occasionally occur in which it is from a fourth to a half of an inch. In cases of very long standing, the cyst is often very firm and indurated, from its conversion into fibrous, cartilaginous, or osseous texture. Under such circumstances, it is not unusual to find it composed of several folds, intimately connected with each other, but differing remarkably in their color, density and thickness, the softest being generally internal, as if they had been secreted by the others. Cases, again, occur, in which the cyst is divided into numerous cells, formed by hard, grayish, intersecting bands.

The object of these cysts evidently is, to serve as barriers to the extension of the pus which they enclose. Rudiments of them are occasionally found as early as the end of the first week ; and, according to Lallemand and Rostan, it is not uncommon to find them perfectly organized at the expiration of a month. Patients thus affected, not unfrequently live for a long time before the brain is so far destroyed as to render the continuance of life impossible. Professor Horner mentions an instance in which the interval between the infliction of the injury — a pistol wound — and the fatal termination was nearly twelve months ; Sir Everard Home, one of nineteen months ; and Dr. Copland, one of upwards of three years. Similar cases are to be found in the writings of Sir Astley Cooper, Hennen, and other surgeons. When the cyst finally becomes the cause of death, it is by exciting fresh inflammation in the surrounding cerebral texture ; or it may, acting in the capacity of a foreign body, excite inflammation in the arachnoid membrane, and destroy life by the consequent effusions.

Abscesses of the brain, however, do not always terminate fatally, for numerous cases occur in which there is every reason to believe that the pus is absorbed, and the cavity of the cyst gradually obliterated by the approximation of its walls. The opinion, at all events, derives confirmation from the appearances of the large cicatrices which are so often found in the brains of old persons, and from the intersecting bands

which are occasionally seen uniting the sides of encysted abscesses.

In respect to its appearance, the pus found in the brain differs in no essential particular from that in other parts of the body. In the generality of cases it is of a pale straw-color, thick, and inodorous; not unfrequently, however, it is greenish, reddish, or dirty white, thin, and remarkably fetid: this is particularly the case in young subjects who die from the extension of inflammation of the ear to the brain. In scrofulous persons, the pus is generally very thick and tenacious, from the admixture, probably, of plastic lymph.

Suppuration of the brain sometimes takes place with great rapidity. Dr. Abercrombie saw a case in which there were several small, undefined abscesses at the end of four days: Laennec asserts that he has known pus to form in less than twenty-four hours. The purulent fluid, when unencysted, often manifests a tendency to pass from its original situation to some other. Thus, when it is seated in one of the hemispheres, it may work its way gradually to the surface, or into one of the ventricles, destroying occasionally, in the former case, the lining membranes, with the contiguous bone. In 1827, I examined the body of a stout, athletic man, about forty years of age, who died nearly three weeks after the removal of an osteo-sarcomatous tumor from the nose by Professor McClellan, of Philadelphia. For the first two weeks after the operation, the patient did remarkably well, and talked of returning to his friends who lived several hundred miles off, in the State of New York. A few days, however, before he had determined on starting, he was suddenly seized with violent rigors, which were followed in a short time by deep coma, and he expired after an interval of thirty-six hours from the attack. On examination, Dr. Gardner and myself found a large, undefined abscess, filled with thick, offensive matter, on the lower surface of the right anterior lobe of the cerebrum, with partial destruction of the cribiform plate of the ethmoid bone and the intervening membrane in its immediate vicinity. Cases, in many respects similar, are narrated by Lallemand, Rostan, and other writers. The symptoms of cerebral abscess do not differ materially from those of the last stages of ordinary inflammation.

Gangrene of the cerebral tissue is a very rare affection, and probably never occurs except as the result of external violence. As an idiopathic disease, I am not sensible that a single

instance of it is to be found in the writings of pathologists. In this affection, the cerebral substance is at first of a reddish brown color, but in a very short time becomes spotted with an immense number of minute grayish points, resting upon a lilac, violet, or purple ground. At a more advanced stage, when the mortification may be considered as fully established, the affected part is converted into a soft, pulpy putrilage of a blackish, brownish, or greenish color, and extremely fetid, — a character which distinguishes this lesion from the simple softening presently to be noticed. The cerebral texture immediately around the sphacelated mass generally forms a hard, reddish belt, highly injected, and occasionally even slightly ecchymosed from sanguineous effusions.

Softening of the brain, a lesion first accurately described by Dr. Rostan, of Paris,* is decidedly the most frequent disease of the whole nervous system, — even more so, perhaps, than apoplectic effusions. It is very common in old subjects, but no age seems to be exempt from it; and, if we may credit the assertions of Billard, one of the most admirable writers on infantile maladies, there is reason to believe that it may exist also as an intra-uterine affection.

There is no part of the encephalic mass in which softening has not, at one period or another, been observed. The structures, however, most liable to it, are such as are most obnoxious to sanguineous effusions, as the fornix, interventricular septum, great commissure, optic thalami, and striated bodies, — the frequency with which they are affected being, according to my own observations, in the order in which they are here enumerated. In the majority of cases, the figurate bodies are alone implicated, the cineritious texture retaining its normal characters; yet instances sometimes occur in which the whole brain and spinal cord are reduced to a soft pulpy matter, with scarcely a trace of their primitive organization. Lesions so extensive are occasionally observed in infants, but are very rarely met with in adults. Of this universal mollescence, as it may be styled, a well-marked example came under my notice in 1836, in a man forty-five years old. Both the white and the gray substance had lost much of their natural firmness and cohesion. The whole of the fornix, excepting its anterior pillars, the interventricular septum, part of the great commissure, and the pineal gland, were completely dissolved.

* *Recherches sur le Ramollissement du Cerveau.* Paris, 1823.

The striated bodies, optic couches, and quadrigeminal tubercles, were likewise much softened ; and so tender was the base of the brain, that the medulla oblongata, cerebral crura, and roots of the nerves, were all left behind in the attempt to remove the organ from the skull. In the cerebellum, the parts which were more particularly diseased, were the cerebello-testicular processes, the Vieussenan valve, and the gray substance at the under surface of each lobe. The vessels of the pia mater in this case were excessively gorged with blood ; and the fibrous texture of the hemispheres, especially of the right, exhibited a considerable number of small rose-colored patches, dappled with black points, corresponding with the orifices of divided capillaries. No lesion, so far as could be discerned, existed in any other organ, and there is every reason to believe that death was occasioned by the diseased state of the brain.

The appearance and consistence of the part affected vary according to the duration of the disease and the intensity of the exciting cause. In the early stages, the changes are always very slight, and can only be recognized by the touch. At a more advanced period, the continuity of the organic particles is sensibly disturbed, and the nervous substance is so soft that it may be readily broken down with the finger into a thin, pap-like mass. It is no longer able to sustain the slightest weight, and has no more consistence, frequently, than so much cream or thickened milk : it may be easily scraped with the knife, but to cut it smoothly is impossible. Having attained this degree of softening, the cerebral tissue soon falls to pieces, forming thus a breach of continuity occasionally of very considerable extent. An odor like sulphureted hydrogen sometimes exhales from the disorganized mass ; but this is very rare, and I have never met with it. According to Billard, it would seem to be more common in children than in adults.

Although the softened parts are occasionally separated from the sound by a distinct line of demarcation, yet more commonly they run insensibly into each other. The color varies according to the time that has elapsed since the invasion. In the early stage, when there is usually a considerable degree of inflammatory turgescence, it is often of a uniform rose tint, studded with red dots, or marked with purple arborescent lines ; more rarely we find small hemorrhagic effusions, and patches of a dark leaden hue, produced doubtless by

intense capillary injection. At a later period of the disorganization, the part is usually of an opaque white, brownish, yellowish, or greenish color; or these tints are blended, different shades of them occurring at different points, or even at the same place. The dull milky hue, which is so frequently observed in this affection, is supposed by Professor Lallemand to be caused by an infiltration of pus,—an opinion which is evidently unfounded, as in the vast majority of cases no such fluid whatever is to be seen. This condition, which is often found after hydrocephalus, the cerebral mass seems to be perfectly anemic, not a drop of blood oozing from the affected part when cut. In some instances, the color remains natural. When this happens, which, however, is rather rare, the softening is usually confined to the fibrous structure, and may readily escape notice.

In this affection, the pia mater is sometimes seriously implicated. When the softening is seated on the convoluted surface of the cerebrum or cerebellum, or on the surface of the striated bodies, and optic couches, the membrane is generally preternaturally red, rough, and, on attempting to raise it, the disorganized gray substance often separates along with it. In other cases, I have found portions of the pia mater completely destroyed, or converted into a dirty brownish pulp, void of every feature of the original texture. These changes are particularly liable to happen when the softening affects the surface of the figurate bodies in the floor of the lateral ventricles. In these cases, the arachnoid frequently experiences the same fate.

Concerning the intimate character of softening of the brain, authors have expressed different opinions. Professor Rècamier views it in the light of a peculiar disease, not unlike certain alterations of the spleen, resulting from a morbid state of the whole system, the force of which is particularly spent upon the encephalic mass. This opinion derives plausibility, in some degree, from certain circumstances to which I shall take occasion presently to advert. Dr. Rostan, who has written a most able treatise on this affection, considers it as a mode of disorganization very similar, in its essential features, to senile gangrene. He supposes it to be an effect merely of inflammatory irritation, referring, in support of his doctrine, to the various phenomena which are exhibited during life, as well as to the appearances which are revealed after death. Very similar to this are the views entertained

by Dr. Abercrombie and Professor Lallemand. The latter of these distinguished writers, nevertheless, asserts that he has occasionally met with cases of mollescence, in which the symptoms have followed so slow and gradual a course, and, withal, have manifested such a degree of mildness, as to preclude the idea almost of inflammatory action. Others, again, mistaking effects for causes, ascribe the lesion to congestion of the cerebral capillaries, or to an effusion of serosity into the intermolecular intervals. It seems to me to be decidedly of an inflammatory origin, — a conjecture which is abundantly borne out both by my own observations and those of some of the distinguished pathologists whose names have just been mentioned.

Softening of the brain is often found in connection with ascites, pulmonary phthisis, diabetes, chronic pleuritis, marasmus, and protracted fevers. Grief, great anxiety, and intense study, are causes which sometimes produce it. This was the appearance which the brain of Sir Walter Scott exhibited. The softening involved nearly the whole of the medullary texture of the left hemisphere, which was converted into a soft, flaccid mass, interspersed with numerous globules of water. This mischief was the result, in all probability, of a slow, chronic irritation, produced by the excessive intellectual labor to which this great man subjected himself during the last five or six years of his existence, in consequence of his pecuniary embarrassments.

Protracted confinement, with inactivity and low diet, also, have a tendency, it would seem, to impair the natural consistence of this noble organ. This circumstance has been remarked by different observers, and is particularly dwelled upon by Dr. Monro, of Edinburgh, in his treatise on the Morbid Anatomy of the Human Brain. Similar appearances have been witnessed in the cerebral tissue of idiots, lunatics, and epileptics. In an elaborate account of the anatomical changes found in the brains of maniacs and epileptic persons, published by Dr. Greding, a German physician, in 1771, fifty-one cases are detailed, in more than one half of which the organ in question was either partially or generally softened. Observations confirmatory of these have since been recorded by other writers. How softening under the circumstances here specified is induced, whether from diminished nutrition of the cerebral texture, or from irritative action, giving rise to an infiltration of serous fluid, into its inter-

molecular spaces is a point which challenges further researches. Old age, also, seems to predispose to this affection ; and the same may be said of arteritis and ossification of the vessels.

As yet no pathologist has succeeded in pointing out any symptom or group of phenomena by which this disease can be distinguished from other encephalic affections. It has been supposed by some, that the rigid contraction of the limbs, so often witnessed in patients who are laboring under this lesion, afforded a characteristic sign ; but the fact that individuals often die in whom the extremities are completely relaxed, is sufficient evidence of the fallacy of the opinion. The duration of the disease is variable. From the observations of Professor Lallemand, it would appear that nearly one half die within the first seven days from the attack ; about two fifths at the end of the second week ; and the remainder at intervals of one, two, or three months. When it is chronic, it may last for years. No treatment seems to be capable of reaching it.

An interesting circumstance in relation to this disease is the fact of its occurring, not unfrequently, in the horse and other animals, both in the brain and spinal cord. The consistence and appearance of the altered texture are the same precisely as in the human subject. Professor Dupuy, of Paris, by whom this fact was first ascertained, states, that the principal symptoms are, trembling of the limbs, general debility, and convulsive movements of the muscles, with tetanic stiffness of the neck, lower-jaw, or extremities, especially the hinder.

Does mollescence of the brain ever get well ? This is an interesting and, practically speaking, a highly important question. As is usual in all such matters, a great contrariety of sentiment prevails among pathologists, which is the more surprising since upon whatever can be determined by direct observation there should always be but one opinion. Professor Andral, who has bestowed a good deal of attention upon the subject, doubts whether it is possible for a cure ever to be effected, especially if the softening have been fully established. In this view he is sustained by several of his countrymen ; whilst opposed to it is the high authority of Cruveilhier, one of the most eminent writers of the present period. "The cicatrization," says he, "of the gray substance is marked by the developement of small cavities with a dense, yellowish scar ; of the white, by the formation of

minute cells, filled with a clear, gelatinous fluid, like thin size." Confirmatory of all this, it is asserted by Dr. John Sims, of England, that the cure of cerebral mollescence is not only possible, but very frequent. In twelve cases of this disease, occurring in old sexagenarian patients, he noticed all the characteristic marks of cicatrization, in different stages of its progress. When fully accomplished, the traces of the cure in the gray substance are a peculiar cribiform aspect of the convoluted surface of the brain, either alone, or combined with atrophy and flattening, and adhesion of the pia mater to the affected part. In the white substance, cicatrization is indicated by numerous little holes, containing a limpid fluid, and lined occasionally by a fine, delicate, transparent membrane, of a light fawn-color. These cells have sometimes a worm-eaten appearance, and not unfrequently they seem as if they had been scooped out with a sharp instrument. In their size, they vary from a pin-head to the volume of a bean; and, in their figure, they strongly resemble the pores observable in new bread. The cerebral tissue in the immediate neighborhood of these cicatrices is either of the natural consistence, slightly softened, or, as is more frequently the case, considerably indurated, according to the period that has elapsed since the commencement of the healing process. Occasionally the white matter has a peculiar granular aspect.

Such is the opinion of Dr. Sims, concerning the cure of mollescence of the gray and white substance of the brain. As regards myself, my observations have been too limited to enable me to speak with that confidence which should ever characterize the statements of the pathological anatomist. Without doubting the accuracy of the investigations of this gentleman, or calling in question the candor of his assertions, I am forced to reject his opinion, that cicatrization is a very frequent occurrence in this affection. At the same time I am far from agreeing with Andral and others, that it can never happen. That it does sometimes take place, is sufficiently proved by the phenomena observable in the mollescence which occurs around apoplectic effusions, and in the neighborhood of morbid growths. The subject, however, requires further elucidation, and, until this be had, no theory, however plausible and ingenious, will be deserving of much confidence.

Chronic inflammation of the cerebral tissue is much more common than acute, of which, indeed, it is not unfrequently

the result. Its anatomical characters, though occasionally similar, are yet, in the great majority of cases, widely different; and it is therefore necessary that they should be considered under a distinct head.

The most important feature of this disease, and one which may be considered as strictly characteristic, is the augmentation of density of the affected tissue, giving rise to that alteration of substance which has been designated, within the last twelve or fifteen years, by the term *induration*. Not a little diversity is observable in regard to the degree of hardening.

In the generality of cases, the consistence does not exceed that of concrete albumen; not unfrequently, however, the part is as firm as cheese; and instances occur, although very rarely, in which it is dense and elastic as fibro-cartilage. The latter species of induration is generally seen in small, insulated masses around old apoplectic cysts, tubercles, and fungous growths. The other two, which often occupy a considerable extent of surface, sometimes coexist, running insensibly into each other. General induration has hitherto been seen chiefly in persons that have died of typhous fever; and Andral tells us that he also witnessed it several times in persons who had been in the habit of working among lead, and who expired in a state of universal convulsion.

The proximate cause of cerebral induration is unquestionably a deposition of lymph into the connecting cellular tissue, by which the intermolecular intervals are filled up, and the fibres of the brain firmly cemented together. That this is the case, is not only analogically inferrible, but may be readily proved by examination with the microscope. A portion of brain thus affected possesses little or no moisture, recoils with elasticity when stretched, and tears with a rough and slightly granulated surface. The natural vascularity is usually very much diminished, probably from an obliteration of some of the capillary vessels; and hence the ordinary color is yellowish white, milky, or grayish, — seldom reddish, brown, or claret, as we find it to be in softening of the cerebral tissue.

Chronic cerebritis, after having existed for some time, may suddenly assume an acute character, and thence pass into suppuration. A shade of green usually announces this event; and, as the process advances, the part gradually acquires a yellow tinge, and a soft, pulpy consistence. The pus is rarely confined in a distinct cavity; on the contrary, it is usually

diffused through the softened mass, oozing out of it, when a section is made, in the form of small globules.

The progress of chronic cerebritis is generally very tardy, especially when it is limited in extent ; and I am not aware that any symptoms have yet been pointed out as diagnostic of its presence.

From the several forms of inflammation, abscess, and softening which have now been described, the transition to *ulceration* is at once easy and natural. This state of the brain, although of very infrequent occurrence, has been noticed by different observers, among whom it will suffice to mention Morgagni, Portal, Howship, Anderson, Scoutetten, Powell, and Andral. It has been found, hitherto, chiefly on the striated bodies, the optic couches, and on the convoluted surface of the cerebrum, in the latter of which situations it is by far most commonly met with.

The ulcers, which seldom penetrate beyond the gray substance, and which affect various forms, have generally rough, indented edges, with an irregular surface, covered, for the most part, with reddened lymph, in some cases with pus, and occasionally even with blood. Instances occur in which they are hard and dry ; and sometimes, though rarely, they communicate together by fistulous tracks, in the same manner as ulcers occasionally do in other parts of the body. In their dimensions they vary from a few lines to several inches, the largest being almost always seated on the external surface of the brain. In a man, twenty-four years of age, who died with all the symptoms of cerebral irritation, complicated with enteritis, Scoutetten found an ulcer, of a pale citron color, on the anterior lobe of one of the hemispheres, thirteen lines long, and seven broad, with a hard, dry surface, and edges singularly indented. The subjacent cerebral matter was perfectly sound, as was all the rest of the brain ; but the arachnoid tunic was throughout deeply injected, and the part of it corresponding to the erosion destroyed. In a case recorded by Dr. Anderson, an English physician, the ulcer was two inches and a half long, one and a half broad, and nearly one in depth. It was situated on the upper part of the right hemisphere, and contained several thin, brownish lamellæ, filled with soft sabulous concretions, so brittle as to break upon the slightest touch.

The cerebral tissue immediately contiguous to these ulcers, usually exhibits signs of inflammation, being of an unnatu-

rally red color, and of varying degrees of consistence. The pia mater and arachnoid are also more or less affected,—a circumstance from which some pathologists have been led to infer that these ulcers rather appertain to them than to the cerebral substance. This, perhaps, with a few exceptions, is true. Occasionally, the ulcer communicates with deep-seated abscesses.

Ulceration of the brain is indicated by headache, partial convulsions, hemiplegy, loss of memory, hebetude, coma, and progressive debility, complicated, not unfrequently, with gastro-enteric irritation.

There are few diseases, a knowledge of which is of more interest to the pathologist, or of greater importance to the practical physician, than that of *cerebral apoplexy*. Occurring at all periods of life, as well as in all parts of the encephalon, it frequently gives rise to the most serious lesions, and demands measures of the most prompt and energetic character. Hence, as might have been anticipated, the lesion under consideration has always been an object of the deepest anxiety with the practitioner, and has elicited from time to time the researches of some of the ablest men of the medical profession. It is only within the last twelve or fifteen years, however, that any real and substantial light has been thrown upon its anatomical characters, its causes, and the nature of its symptoms.

The term apoplexy is of Greek derivation, and literally signifies a stroke or blow. The lesion which it serves to designate, and which invariably depends upon sanguineous effusion, exhibits a remarkable variety as to its seat and extent. In many cases, the blood is poured into the substance of the brain; in some, upon the external surface; and in some, again, into the ventricles. Of these three forms, the last is by far the least frequent; next to this is the meningeal, or that in which the fluid is extravasated upon the surface of the brain; and the most common of all, is where it is diffused through the cerebral tissue. It has also been found that certain parts of the encephalic mass are much more liable to hemorrhage than others. Of three hundred and ninety-two cases of this disease, collected by Andral from the writings of different pathologists, two hundred and two affected the interior of the cerebral hemispheres on a level with the floor of the lateral ventricles; in sixty-one, it was seated in the striated bodies, and in thirty-five, in the optic couches. The cere-

bellum is rarely affected, and the same is true in regard to the rest of the cerebrum. Of the reason of this greater liability of some portions of the encephalic mass to sanguineous effusions than others, we are still in profound ignorance. That the difference depends, however, upon some difference of vascularity or upon some difference in the atomic constituents of the cerebral texture, it is both legitimate and philosophical to infer; yet that such is really the case, it would be highly extravagant, in the present state of our knowledge, to assert. Further observations are alone competent to determine the truth or fallacy of the supposition.

In regard to the extent of these extravasations, the greatest possible variety obtains. Often the quantity is very trifling, not exceeding a few drops, or the volume of an ordinary pea; sometimes, however, the effusion is quite copious. In one instance, in a female fifty-six years of age, I found it amounting to nearly eight ounces; and still more remarkable examples are recorded by authors. The number of extravasations is also liable to much variation. Very frequently, there is only a solitary one, whilst at other times there are as many as ten or a dozen. When numerous, the sanguineous depots usually exhibit different appearances, as if they had occurred at different periods.

The appearance of the extravasated blood varies, as has just been intimated, according to the length of time which elapses between the attack and the death of the patient. When the apoplexy proves suddenly fatal, the fluid is dark colored, almost fluid, or in soft semi-liquid masses. If the individual survive for a longer period, the clot acquires a greater degree of consistence, and is of a pale red, grayish, or yellowish tint. At a still more advanced stage, it becomes hard, dense, and fibrinous, and is either organized, partially or entirely absorbed, or converted into a loose, drab-colored cellular substance, presenting, when cut, a peculiar appearance, not unlike that of a honey-comb. These changes usually begin within the first fortnight after the attack, and are completed at the expiration of several months, the length of time being always greater in proportion to the size of the clot. Riobe found blood in an apoplectic cavity after twenty months, and Serres at the end of several years.

The substance of the brain around the extravasated blood often presents important lesions, consisting chiefly in a change of color and consistence. Very frequently, it is softened,

lacerated, and infiltrated with serosity, with blood, or even with puriform matter, or perhaps all these fluids are found in intimate combination. The color, in such cases, is either natural, reddish, yellowish, or greenish, according to the degree of capillary injection, or the amount of inflammatory irritation. In some instances, we find the apoplectic cavity intersected with shreds of cerebral substance, which are so incorporated with the extravasated fluid as to be no longer distinguishable from it. In chronic cases, the surrounding parts are more commonly indurated and brittle; but this occurrence is by no means constant, as every one can testify, who is in the habit of making post mortem examinations.

Often the effused blood is surrounded by a distinct cyst, formed by a deposition of lymph, from the fourth of a line to the eighth of an inch in thickness. At first, the sac is soft, the substance of which it is composed resembling very much that which is poured upon the edges of an inflamed wound; but by degrees it acquires greater consistence, and is finally completely organized, its parietes being abundantly supplied with vessels, which not unfrequently extend even into the enclosed clot itself. Its external surface is generally rough and flocculent, and the cerebral tissue immediately around it is variously altered, being sometimes softened, sometimes infiltrated with pus, sometimes indurated. In time, the sac becomes both an absorbing and a secreting texture, as is evinced by the fact, that its interior is often filled with substances which are quite different from those that were deposited in the first instance; and also by the circumstance, that it is sometimes completely cicatrized, its walls being brought so closely together as to leave merely a hard, fibrous scar.

The number of these apoplectic cysts usually corresponds with the number of sanguineous effusions which have at different times taken place; and hence several of them are occasionally seen in different parts of the same brain. In examining, not long since, an old man who died of softening of the brain, produced by the irritation of a large clot of blood, I found as many as a dozen of such sacs scattered through various portions of the cerebral hemispheres, the biggest of which scarcely equaled a hazelnut: they were of a yellowish color, of the consistence of cellular tissue, and each marked off into several little cavities, filled with a thin, turbid serosity.

All these facts are extremely interesting, as showing how

much may be effected by the reparative powers of the system. No sooner has the effusion taken place, than nature sets up her work of reparation, and in this she is often so successful that in the course of a short time the clot is either absorbed, encysted, or so altered in its physical and vital properties, as to be no longer viewed by the organ in the light of a foreign body. There are several circumstances which favor the absorption of the coagulum, but none so powerfully as a healthy condition of the whole cerebral circulation. This fact, as the reflecting reader will perceive, is one of great practical moment, as it loudly inculcates the importance of paying attention to the head, long after the apoplectic seizure has taken place.

Concerning the *sources* of these sanguineous effusions, little need be said in this place. From the researches of Dr. Serres, a recent French writer, it appears that the blood may, in some instances, proceed from the minute vessels of the brain without rupture, constituting that variety of the disease to which some pathologists have applied the term *meningeal apoplexy*. The fluid, in such cases, escapes from the pia mater into the intergyral hollows, or into the ventricular chambers, or, finally, into the substance of the brain, which itself remains sound. When blood is found in the cerebral cavities, it may be concluded that it has proceeded from the source just mentioned, or from rupture of the vessels of the choroid, or from a communication with an apoplectic cavity in one of the hemispheres.

The hemorrhage, however, most usually results from rupture of the vessels, caused by a diseased condition of their tunics, and a consequent inability to withstand the shock of the circulating fluids. In several instances I have satisfactorily traced the effusion to this source. Occasionally, the lesion is associated with aneurismal tumors,* laceration of the cerebral sinuses, or ossification of the meninges. In infants it is sometimes induced by the pressure which is exerted upon the head during parturition. The blood, in such cases, is usually poured upon the surface of the brain and spinal cord, in the form of a layer, of variable thickness and extent.

Apoplexy has been observed at all periods of life. The late Dr. Billard, of Paris, has recorded an instance which

* See the interesting case of aneurism of the basilar artery, by Dr. Serres, in "Archives de Médecine," vol. x. p. 419.

took place in an infant soon after birth ; and Dr. Serres relates another which occurred in a child of three months. Stokes, Guersent, and Andral, have also met with cases at a very tender age. Nevertheless, the lesion is much more common in the old than in the young. Dr. Rochoux,* in an able essay on this disease, has shown that the most obnoxious period decidedly is between the sixtieth and seventieth years. In sixty-nine cases noticed by this distinguished pathologist, two occurred between the twentieth and thirtieth years ; ten between the thirtieth and fortieth ; seven between the fortieth and fiftieth ; thirteen between the fiftieth and sixtieth ; twenty-four between the sixtieth and seventieth ; twelve between the seventieth and eightieth ; and one between the eightieth and ninetieth. Similar observations have been made by Lerminier, Serres, and other authors.

But this is not the only cause which operates in the production of apoplexy in old subjects. The nervous pulp, in advanced life, frequently undergoes a remarkable degree of softening ; and this lesion seldom exists very long, there is reason to believe, without being followed by sanguineous effusions. These depots were formerly regarded merely as a secondary lesion ; but Professor Lallemand, of Paris, has clearly shown that, so far from being the case, the softening generally precedes the hemorrhage, and is one of the principal causes of its occurrence.

The form of the body, also, appears to give a predisposition to the disease, as a large head, short neck, broad shoulders, and corpulency of habit ; though this is probably much less frequent than is generally imagined. In the cases analyzed by Rochoux, only ten were fat and plethoric persons, whilst the rest were either spare and thin, or of the ordinary make of frame. Apoplexy is of more frequent occurrence in men than in women, — probably from the former being more addicted to all kinds of excesses, both bodily and mental, than the latter.

Of the greater prevalence of this disease in the male than in the female sex, the statistical tables of M. Falret furnish conclusive evidence. Of two thousand two hundred and ninety-seven cases of apoplexy which occurred amongst the inmates of the Lunatic Asylum near Paris, from 1794 to 1823, including a period of twenty-nine years, sixteen hundred and

* *Recherches sur l'Apoplexie*, p. 418. Paris, 1833.

seventy belonged to the former, and six hundred and twenty-seven to the latter, or in the proportion nearly of three to one.

Occasionally there would seem to be a hereditary proclivity to this disease, nearly as much so as in tubercular phthisis. Examples of this kind are related by Portal, Frank, and Cheyne, and must be quite familiar to every observant practitioner. It has been supposed by some, that cerebral hemorrhage is more common at certain seasons of the year than at others; but this opinion appears to be directly contradicted by the observations of Rochoux.* Of the sixty-nine cases of this lesion observed by this able writer, sixteen occurred in the spring, nineteen in the summer, eighteen in the autumn, and sixteen in the winter.

The symptoms of cerebral apoplexy being minutely described in our practical treatises, I deem it unnecessary to dwell upon them here. I will only further remark, therefore, in concluding this subject, that one of the most interesting and important circumstances connected with encephalic effusions, whether of blood, of water, or of matter, is, that the paralysis which so often attends them occurs nearly always on the side of the body which is opposite to that on which the extravasation has its seat. So common is this phenomenon that, in the language of an able pathologist,† it may be considered as a law, the most general, perhaps, of any in medicine. Thus, when there is a clot of blood in the right hemisphere, there will be palsy of the left side; and, conversely, when there is effusion on the left side, there will be loss of motion on the right. The reason of this must be obvious to every one who has a knowledge of the decussation of the fibres of the medulla oblongata; for it need scarcely be observed that it is upon this that it depends. The occurrence, however, is by no means invariable, — an anomaly for which it is difficult to account.

In addition to the several forms of cerebral disease which have now been passed in review, and which may almost all be considered, in some way or other, as the result of inflammatory irritation, there are various morbid growths to which it will be necessary, in the next place, to turn our attention.

Amongst these productions the most important, in a pathological point of view, are tubercles, melanosis, encephaloïd,

* Op. cit. p. 429.

† Stokes, on Apoplexy. American Journal of Med. Science, vol. xvii. p. 188.

cartilaginous transformations, calcareous depositions, serous cysts, hydatids, adipons and adenoid tumors. To each of these subjects, a few remarks will be appropriated; premising, however, that, as the symptoms which they occasion are often extremely obscure, and never, perhaps, pathognomonic, nothing whatever will be said concerning them.

Tubercles of the brain are found chiefly in childhood, being seldom observed in very young infants, and still more rarely in adults. The disease, there is reason to believe, is of very infrequent occurrence in the United States; for, extensively as I have been engaged in making post-mortem examinations, never have I seen it, except in one solitary instance. When present, it is commonly associated with a scrofulous habit of the constitution, and hence occurs most frequently in conjunction with tubercles of the other organs, especially of the lungs, spleen, and mesenteric ganglions.

The localities of the brain in which tubercles are most commonly found are, the cerebral hemispheres, cerebellum, great commissure, medulla oblongata, cerebral and cerebellic crura, the optic thalami, and striated bodies, — the frequency of their occurrence being in the order here enumerated.* They may occupy, indifferently, either the cortical or fibrous substance; and may occur either in groups, or, as is more commonly the case, in disseminated masses.

The number of these bodies seldom exceeds half a dozen; nevertheless, cases occasionally occur in which we find as many as fifty, seventy-five, or even a hundred. In size, they vary from that of a pea to that of a ripe walnut, their magnitude being generally in an inverse ratio to their number. Not unfrequently they are so large as to occupy the greater part of one of the lobes of the cerebellum, or of one of the hemispheres of the cerebrum. In form, they closely resemble tubercles in other organs and textures of the body. In some instances, especially when they are clustered together — which, however, is very rare — they are uneven, nodulated, and separated into lobes, connected by pretty dense cellular tissue. Their color is a pale yellow, white or bluish, and their consistence like soft cheese, though occasionally much firmer.

Apparently void of vessels, these bodies exhibit no trace whatever of being organized; yet that they are so, cannot, I think, be well doubted. In the generality of cases, if not

* Andral, Pathological Anatomy, vol. ii. p. 485.

always, they are surrounded by a distinct cyst, often remarkably thin, but which now and then is of great thickness, and of a fibrous, cartilaginous, or even bony texture. Of the manner of their formation little is known ; but that they are here, as elsewhere, the result of a peculiar inflammatory process, is more than probable.

After these tubercles have existed for some time, varying according to circumstances, they assume an opaque, dusky appearance, and are finally converted into a soft cheesy matter, precisely analogous to that of tubercles in other situations. Numerous abscesses are thus occasionally formed, which may be readily discriminated from such as are of a simple inflammatory origin, by the nature of their contents.

The cerebral tissue around these tubercles is variously affected. During the early periods of their formation, it is not unfrequently quite natural ; but, as they proceed in their developement, inflammation is often excited, which generally leads to induration, softening, or purulent infiltration.

Melanosis of the brain has been noticed by different authors, but as yet I have not been so fortunate as to meet with an instance of it. All writers agree in the opinion that it is among the most rare productions to which this organ is liable. Both Hooper and Carswell have beautifully delineated this heterologous formation of the brain. Though it occasionally occurs in small dots and narrow streaks, the most common form under which it appears, is that of spherical masses, of a jet-black, brownish, or liver color, varying in size, from a mustard-seed to that of a hen's egg. They are distinctly circumscribed, but apparently without any cyst, and closely surrounded by healthy brain, from which they can be easily lifted with the forceps. Vessels may frequently be traced into their interior ; and, when they are seated on the convoluted or figurate surface of the organ, it is not unusual to find them intimately adhering to the pia mater. Their softness is often remarkable, the black coloring matter which they contain being nearly as fluid as ink.

If these tumors be divided with a sharp knife, and washed with water, the coloring matter disappears, and nothing but a soft, shaggy substance remains, probably of a cellulo-fibrous nature. This, no doubt, is the *nidus* in which the melanotic matter is originally deposited.

Encephaloid is occasionally met with in the brain, though much less frequently than in other parts of the body. It

occurs chiefly in young subjects, before the age of twenty, in the form of soft, spongy, compressible tumors, enveloped by a distinct cyst. Their surface is frequently lobulated, and their interior closely resembles the gray substance of the brain, with a tinge of red. When cut with a knife, the section is smooth, and the instrument is covered with a soft, unctuous, cream-like matter. The capsule itself, varying in thickness from one to several lines, is often of a deep reddish color, liberally furnished with vessels, externally flocculent, and closely adherent to the surrounding parts. Solid masses of extravasated blood are occasionally intermixed with these tumors; and in many cases the cerebral tissue immediately around them is in a state of softening.

Masses of *cartilage* have sometimes been found in the brain; but they have never come under my own observation, and are very uncommon. Occasionally they attain a very considerable volume. In a case given by Dr. Monro, the tumor was as large as the two fists. They are generally of an irregularly rounded shape, with a rough, lobulated surface; of a dense, gristly hardness; and of an opaque, bluish color; presenting, when cut, a radiating, fibrous arrangement, not unlike an unripe pear.

When old, these cartilaginous tumors not unfrequently contain small cavities, filled with curdy, gelatinous, or sanguinolent matter. Under no circumstances, so far as I can learn, are they enveloped by any cyst.

Equally infrequent are those *calcareous deposits* which have been described by authors as being sometimes found in the brain. They may occur at all periods of life, but are much more common in the old than in the young; and consumptive subjects are said to be more prone to them than any other class of people. The form in which they mostly appear is that of scattered granules, about the size and shape of saw-dust; often, however, they are seen in irregular nodules, varying in volume from a small pea to a large plum. Composed chiefly of phosphate of lime, in combination with a minute proportion of animal substance, these concretions are commonly of the consistence of dry mortar, and readily yield to the pressure of the finger. Cases have been observed in which they have been formed of alternate layers of chalky matter and solid albumen. Their color is ordinarily somewhat reddish; their surface rough, lobulated, or spicular; and, in most instances, they are surrounded and connected to the

contiguous cerebral substance, by a delicate, vascular membrane.

The number of these granular concretions is sometimes immense. Dr. Hooper tells us that he has seen the greater part of the fibrous structure of one of the cerebral hemispheres converted into a soft, brownish mass, literally filled with small gritty particles, none of which were visible to the naked eye, and which felt between the fingers as if sand were mixed with it. Some of the small vessels of the brain are occasionally ossified, so as to present the appearance of thin, white bristles. Of this I have seen several examples, principally in very aged subjects. In one, an old man of upwards of sixty, they were extremely numerous, and occupied the greater part of the posterior lobe of the left hemisphere.

Nowhere are these concretions so common as in the pineal gland. In this situation, they are almost always agglomerated into an irregular-shaped mass, varying in magnitude from a pin-head to an apple-seed, the largest being usually in the centre. They are of a yellow citron color, hard, rough, and gritty, and, what is remarkable, are never found until about the age of seven or eight years. After this period, there are few individuals in whose brains they do not occur. Their presence do not seem to occasion any particular inconvenience; yet Descartes and some of his disciples thought that they might often be a cause of mental derangement.

Small *cysts*, containing a transparent yellowish fluid, of the character and consistence of serum, are sometimes met with in different parts of the brain, especially at its base, on the floor of the lateral ventricles, and on the convoluted surface of the hemispheres. Of this variety of morbid growth, I have never seen but one example, which was in a child ten months of age, that died of hydrocephalus. The tumor, which was situated at the posterior and inner part of the right ventricle, which itself was enormously enlarged, was about the size and shape of a hen's egg, with perfectly smooth, polished, and transparent coats, not thicker than the healthy omentum. The fluid which it contained was thin and colorless, like the clearest spring-water. But such are not always the appearance of these cysts. Often they are quite opaque, speckled with grayish dots, and almost of the thickness and density of the pericardium. Their contents, in such cases, are of a milky white, gelatinous, and readily coagulate by heat, which is not the case when their struc-

ture is very delicate. Several such tumors are occasionally found in the same brain, either in different parts or in close proximity with each other. Hooper has delineated a case in which three vesicles, each nearly as large as an orange, were embedded close together in the right hemisphere, occupying almost the whole of the anterior and middle lobes. That these structures are organized, is sufficiently shown by the fact that numerous vessels, of the most delicate appearance, are frequently seen ramifying through their walls.

There is another species of vesicular tumor which is occasionally seen in the substance of the brain, but the occurrence of which is much less frequent than the one I have just described. It is the *acephalocyst*, or headless hydatid. This animal, which has a life of its own, is enclosed in a distinct membranous sac, and seldom acquires any great size. Dr. Rostan mentions a case, however, in which the cyst was five inches in length; and a still more remarkable one is referred to by Dr. Abercombie, in which it was of the dimensions nearly of a tin cup. It occurred in an old man, occupied the left ventricle, and was perfectly distinct from the choroid plexus. The fluid of this species of tumor is generally remarkably thin and pellucid. Although it is stated by numerous authors that they have seen examples of this headless hydatid, yet its occurrence is acknowledged to be extremely rare; and Dr. Hooper informs us that, although he has inspected several thousand subjects, he has never met with it in the brain.

The *bladder-tailed hydatid*, the *cysticercus cellulosus* of naturalists, has never been found in the human brain; and, though cases of it are mentioned by authors, it is doubtful whether they are authentic.

The *adipous tumor* is rarely found in the brain. It varies in size from a small hickory-nut to a hen's egg; is rough and lobulated on the surface; of the color of fat or adipocire, and of the consistence of spermaceti, tallow, or soft wax. A fine delicate, vascular cyst usually envelopes it; and, when divided, it is found to be composed of very minute and closely aggregated lobules. Occasionally it is made up of concentric layers, united by dense cellular tissue; and Otto saw a tumor of this kind which contained hair.

Our knowledge concerning the precise nature of this tumor is still somewhat unsatisfactory. Chemical analysis, however, has shown that it consists principally of fatty matter, with

a minute amount of cholesterine. This latter ingredient is so much the more remarkable, as it has been ascertained, recently, that the human brain always contains a small quantity of it in the normal state.

The *adenoid* tumor does not seem to have been much noticed by pathologists, either ancient or modern, and hence we may justly adopt the conclusion that it is of rare occurrence. Most generally of the size of a small nut, and of an oblong shape, it is of a pale flesh color, hard, firm, but somewhat spongy in its texture, and enveloped by an appropriate vascular covering, having apparently very little connection with the cerebral substance. It may occur in any part of the brain, and in some instances is scattered in considerable numbers through different portions of it. In a case mentioned by Mr. Earle, of London, not less than seven such tumors were found in the substance of the right hemisphere of a child under three years of age; the largest about the size of an orange, the smallest of a chestnut. They were of a very firm texture, and of a dusky red color, like an absorbent gland, interspersed with streaks of white.

The origin of adenoid tumors is still involved in obscurity. Taking into consideration, however, their fibrous texture, and flesh-colored aspect, it appears to be not improbable that, in the generality of cases at least, they are the result of apoplectic effusions, the blood being merely deprived of some of its red particles, and the remainder modified in such a way as to assume the characters which appertain to this sort of growth. The supposition certainly derives great support from the fact that the subjects of these tumors are for the most part persons who have labored, at one time or other, under symptoms of palsy, apoplexy, epilepsy, or mental derangement.

The brain is sometimes *hypertrophied*. In this state, which was already known to Morgagni, and which has been more recently described by some of the French anatomists, especially by Dr. Dance and Dr. Scoutetten, the convolutions of the brain are singularly compressed and flattened, and the intervals between them almost obliterated,—the investing membranes being at the same time partially stretched, and appearing as if they were too tight for the enclosed mass. The ventricles are very nearly effaced, and the various surfaces of the organ deprived of their ordinary moisture. The cerebral substance is unusually firm, almost destitute of blood,

and appears remarkable dry when cut.* The hypertrophy commonly involves both hemispheres; occasionally, however, it is confined to particular parts; and in some instances the increased growth is so great as to produce an evident enlargement of the skull. No example of this affection has yet been met with, so far as I know, in the cerebellum; which, considering the functions of that portion of the great nervous centre, is rather extraordinary. It is chiefly witnessed in children and very young persons, particularly in such as are subject to frequent attacks of epilepsy; but even in them it is extremely rare. Dr. Copland states that he has met with it only three times in several thousand cases.†

The opposite of this state, *atrophy*, is sometimes witnessed. In idiots, in cases of hydrocephalus, and in aged persons, the brain occasionally undergoes a remarkable diminution in all its parts, both gray and white; and the same circumstance is not unfrequently observed in young people who have suffered from long-continued wasting disorders. The marks by which atrophy may be recognized are, a flaccid and shrunken state of the convolutions, interstitial cellular infiltration, peculiar stringiness of the cerebral pulp, and dilatation of the blood-vessels, either empty or filled. Conjoined with these appearances are usually thickening of the cranial bones, and distension of the ventricles.

Like hypertrophy, the affection in question may be general or partial. The latter variety is most commonly seen in the striated bodies and optic couches. In place of the natural rotundity, the surface of these structures is remarkably flattened, contracted in its dimensions, or even scooped out, as it were; and, on cutting into them, their substance appears loose and cellinated. Very frequent instances of partial atrophy are witnessed on the convolutions, which are either smaller and less numerous than usual, or almost wholly absent. In such cases there is often very little gray matter. Atrophy of the cerebellum is by no means uncommon, and sometimes amounts to almost entire absence of this portion of the encephalic mass.

* See Dr. Dance's account of this affection, in the fifth volume of the "Répertoire d'Anatomie," &c. Paris, 1828.

† Dictionary of Practical Medicine, p. 218.

SECTION IV.

Of the Spinal Cord.

HAVING already dwelled at considerable length upon the anatomical characters and diagnostic phenomena of the various lesions of the encephalon, it only remains to make a few remarks concerning those of the spinal cord ; and these will be so much the more concise, inasmuch as the foregoing observations embrace nearly all that might otherwise be necessary to be said under the present head.

Suppuration of the spinal cord is attended by nearly the same symptoms and anatomical characters as that of the brain, making proper allowance, of course, for the difference of function of these two organs. The following case, which I quote from the admirable work of Dr. Abercrombie, conveys an accurate idea of the phenomena which this disease exhibits before and after death. A young soldier, shortly after recovering from an attack of petechial fever, was affected with pain in the back, difficulty of moving the inferior extremities, retention of urine, and involuntary discharge of fœces, with general debility, and emaciation. This state of things was succeeded, in a few months, by perfect paralysis, first of the lower, and soon after the upper limbs. He then lost his speech, became completely immovable, and expired suddenly, a fortnight after, in the full possession of his intellectual faculties. On inspection, a large quantity of serous fluid flowed from the spinal canal, and the cord itself, at the part corresponding to the inferior portion of the dorsal region, was suppurated, and converted into a soft, pulpy mass. Above this point, the cord preserved its natural figure, but was much reduced in consistence. The investing membranes, and the periosteum lining the vertebral canal, were destroyed along the principal seat of the disease ; but the bones themselves, and their ligaments, were sound.

In another case, occurring in a woman fifty-six years of age, and narrated by Professor Velpeau, of Paris, the cervical portion of the spinal cord presented a cavity three inches in length by three lines in diameter, which was filled with soft, purulent matter, mixed with gray substance. The membranes were considerably indurated, and the walls of the

abscess hard, firm, and about the eighth of an inch in thickness. The patient, in this case, was affected with sudden loss of power of the limbs of the left side, which soon amounted to perfect palsy, without deprivation of feeling. The speech was embarrassed, the voice very feeble, the respiration quick and humid, and the left arm œdematosus. In four days, she could make herself no longer understood; the strength rapidly failed, stertorous breathing supervened, and in a week she expired.

Abscesses of the spinal cord are extremely rare, and, so far as I am aware, besides the above case, only two others are on record. One of these is by Dr. Carswell, of London, and the other by Dr. Hart, of Dublin. Both Andral and Abercrombie state that they have never met with them.

Softening of the spinal cord is not uncommon, and, as in the brain, may be either partial or general. In some instances, it is limited entirely to the internal gray substance; and cases occur in which the disorganized texture exhales an odor similar to that of sulphureted hydrogen.

Induration of the spinal cord, although it chiefly affects the white substance, is yet sometimes entirely confined to the gray. The affection occasionally embraces the whole cord, from one extremity to the other. In such cases, the induration may be carried to such a degree as to enable the structure in question, after being divested of its tunics, to sustain a considerable weight. Of this, a remarkable case has been given by Dr. Billard, of Paris, in an infant that died soon after birth from convulsions. On inspection, the whole cord was found to be indurated, and so strong as to be able to support nearly a pound weight. The meninges were lined with a thick, adventitious membrane.

Tubercles, sanguineous and serous effusions, and various kinds of tumors, are sometimes met with in the spinal cord, or in its membranes; but these it is unnecessary to describe, inasmuch as they are of the same nature precisely as in the brain. Ulceration of the spinal cord has not, I believe, ever been discovered.

Hypertrophy of the spinal cord is sufficiently uncommon, much more so, indeed, than in the brain. The affection is characterized by the enlargement and extreme firmness of the cord, with diminution of the natural vascularity, and has hitherto been noticed principally in children. Occurring generally in isolated portions, the hypertrophy is sometimes

observed throughout the whole extent of the cord, and may attain such a degree as to fill up, completely, the cavity of the vertebral canal.

Atrophy of the spinal cord is occasionally observed. Dr. Ollivier, of Paris, gives an account of two cases of this affection, in one of which the cord was reduced, throughout its whole extent, to about two thirds of the natural bulk, in the other to one half. In most instances, however, the atrophy is partial, that is, limited to particular portions. The spinal cord is sometimes absent as a congenital defect; and instances are occasionally observed, in which it is hollow, at the expense, evidently, of the central gray substance.

It only remains that we should add to this rapid sketch a few remarks on the subject of *hydro-rachitis*. This is a congenital deformity, consisting in a cleft condition of the vertebral column with a protrusion of the lining membranes of the spinal cord. The lesion, which is evidently caused by an arrest of ossification, and a consequent deficiency of the vertebral rings, is generally situated in the lumbar region, but occasionally it affects the dorsal or cervical portions, or even those of the sacrum. It is frequently associated with hydrocephalus, and is precisely analogous to all those malformations which originate from a want of union of the two halves of the fœtus during utero-gestation, such as hair-lip, cleft-palate, and opening of the linea alba.

The protrusion of the spinal envelopes generally takes place during the latter months of fœtal life; occasionally, however, it is not observed until some weeks or even months after birth. When the tumor first shows itself, it is perhaps not larger than a pea; but, as the disorder progresses, it gradually increases in size, varying in proportion to the deficiency of the vertebræ. Although, in the plurality of cases, the swelling does not exceed an orange, yet occasionally it reaches the magnitude of the fist, or even that of the patient's head. The skin is commonly very smooth, delicate and thin; sometimes, however, it retains its normal thickness, or it becomes red, rugose, and horny: in a few rare cases, it has been known to be entirely wanting. The tumor is either soft, flabby, and fluctuating, or it is full, hard, and shining: when pressed upon, it gradually diminishes in volume, or even quite disappears; but no sooner is the force removed than the fluid reaccumulates, and the part regains its previous bulk. In its form, the swelling is globular, ovoidal, or

pearlike, with a short, narrow neck, by which it reposes upon the cleft bone.

The fluid of a tumor of this kind is generally of a thin, limpid character, slightly saline in its taste, and almost uncoagulable. The best analysis that has been furnished of it is by Berzelius, according to which it consists of the following ingredients :

Water,	97.8
Muriate of soda,	1.0
Albumen,	0.5
Mucus,	0.5
Gelatine,	0.2
	<hr/>
	100.0

In some instances, the fluid is of the color and consistence of synovia, or it contains flakes of lymph and particles of pus. These appearances are seldom present until after the tumor has burst, and discharged its original contents. In regard to its precise seat, it may be mentioned that it is most frequently found in the arachnoid sac, but occasionally it has been known to exist between it and the pia mater, between it and the dura mater, and sometimes, though rarely, in all these situations at the same time. The tumor usually consists of one, but in a few rare instances of two or more distinct cysts, as in the multilocular variety of ovarian dropsy. In such a case it would be difficult, if not impossible, to draw off all the fluid by a surgical operation.

The contents of the vertebral canal, in the immediate neighborhood of the lesion, are variously affected. The portion of the spinal cord surrounded by the tumor is often very much softened or converted into a thin, diffluent substance : sometimes it has been found abnormally hard ; sometimes it is not so large as natural ; and sometimes it deviates remarkably from its accustomed route, being forced through the opening in the vertebræ, and partially contained in the swelling. The nerves are always more or less displaced, and, in some instances, they are dragged out of the spinal canal, and distributed over the internal surface of the cyst in a beautiful plexiform manner, ingeniously compared by Burgius to the fleshy columns of the heart. The arachnoid membrane and dura mater are usually not much altered in the early stage of the affection ; but, as the fluid accumulates, they become excessively attenuated, and, together with the

superimposed skin, finally give way in one or more places. When this happens, the parietes of the tumor shrink, and become greatly thickened, by the deposition of plastic lymph upon their interior. A thin, turbid fluid, mixed with pus, continues to exude from the part, and the patient is rapidly carried off by constitutional irritation. The preternatural aperture is ordinarily limited to the posterior surface of the bone, but sometimes it extends through its whole substance, so that the finger may be readily passed into the abdomen, or coils of intestine find their way into the tumor.

SECTION V.

Of the Nerves and their Ganglia.

CONSIDERING their connections and functions, the nerves may be divided into two general classes,—the encephalo-spinal and the sympathetic. The former, as their name imports, extend from the encephalon and spinal cord to sentient and irritable textures, acting thus as sentients to the parts between which they are situated. The latter form a system by themselves, but freely communicate with the other by appropriate filaments: they reach from the cranium to the pelvis, lying along the vertebral column, and are particularly distinguished by a chain of ganglia, each of which is thought to be a special centre of the nervous influence. The distribution of their branches is very extensive, as much so, apparently, as that of the encephalo-spinal nerves; and their chief duty is to preside over the functions of organic life.

The form of the nerves is in general cylindrical; but, as they proceed to their termination, they become somewhat flattened, particularly those which lie immediately beneath the skin. The aggregate of their branches, like that of the blood-vessels, is greater than that of the trunks from which they arise; and hence they may be considered as gradually augmenting in size as they extend from their origin towards their points of destination. The encephalo-spinal nerves seem to be all implanted into the fibrous texture of the great central mass; but this is rather apparent than real; for, by a

careful dissection, they can be distinctly traced as far as the granular matter. This connection, which was first noticed by the celebrated French anatomist, Vieq d'Azyr, has been particularly insisted upon by Gall, and is now generally admitted by the profession. Each cord arises alike by two roots, one from the anterior, the other from the posterior lateral groove. This remark holds good only of the spinal nerves: the origin of the encephalic nerves is less uniform and simple. In what mode the nerves terminate is a point which has not been ascertained, excepting in the instance of the optic and auditory, each of which expand into a soft, delicate, and transparent pulp, that becomes opaque soon after death. All that is known with any degree of certainty is, that, as they approach their final destination, they assume a peculiarly pulpy aspect, owing, no doubt, to the excessive attenuation of their neurilema.

The encephalo-spinal nerves, viewed in reference to their functions, are divisible into three classes,—the sensific, motor, and respiratory. The first set, with the exception of the olfactory, optic, and auditory nerves, all arise from the posterior part of the spinal marrow, and are connected each with a spherical ganglion, which is situated within the vertebral canal, and the section of which deprives the parts supplied by their corresponding filaments of sensation. The motor nerves take their origin from the anterior column of the spinal cord, and are distributed to the voluntary muscles. The nerves of the third class are detached from the “respiratory tract,” so beautifully delineated by Sir Charles Bell. This term is applied to a rod of white nervous matter which is interposed between the roots of the other nerves, from the annular protuberance as low down as the first dorsal vertebra. The nerves which arise from it have single roots, but they all commence by a series of minute fibrils: they possess the power of associating the muscles upon which they are spent, with the general respiratory movements, and their importance is therefore felt at every moment of our existence. They consist of the pathetic and facial nerves, the glosso-pharyngeal, spinal accessory, the phrenic, external thoracic, and the pneumo-gastric,—the latter of which is the great centre of the respiratory system.

Although the nerves are distributed in every direction through the body, yet they do not terminate in all the tissues indiscriminately. The parts in which they are most abundantly found are the eye, ear, and nose, the external and

internal teguments, the voluntary and involuntary muscles, the lungs, liver, spleen, and kidney. The blood-vessels, bones, and fibrous textures, are sparingly supplied, particularly the two last. The parts in which no nerves have hitherto been discovered are the ligaments and tendons, the cellular substance, the fibro-cartilages, and cartilages, the serous and synovial membranes, the humors of the eye, the epidermis, nails and hair, the lymphatic ganglions, and, lastly, the cerebro-spinal mass, — the source and fountain of all sensation.

There are three modes by which the nerves are connected with each other, namely, by anastomosis, by plexus, and by ganglia. Of these, the first is generally found between branches of the same class of nerves, but occasionally between those of opposite ones. Thus, the intercostal nerves, as they are called, freely anastomose with the filaments of the sympathetic; the branches of the fifth pair, which is a sensific nerve, with those of the seventh, which is a respiratory nerve. A plexus (Fig. 44) is only a more multiplied and intricate anastomosis. The most remarkable example of this kind of intercourse is furnished by the reciprocal interlacement of the axillary nerves.

Ganglia (Fig. 45) are small nodules, of a reddish gray color, which consist of an interlacement of fine nervous fibrils, held together by soft, cellular substance. In size, they vary in different parts of the body, from that of a pin head to that of a kidney bean; usually they are somewhat flattened, and of an irregularly oval shape. They are of a firm consistence, yet easily compressed; and, when divided, they exhibit somewhat of a pulpy appearance. Like the corresponding bodies in the

Fig. 44.

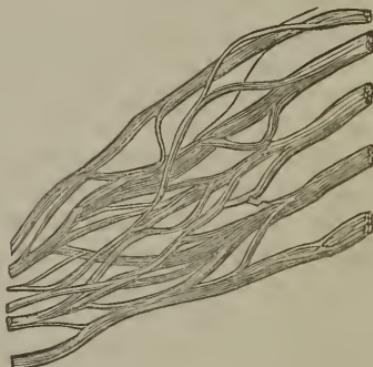
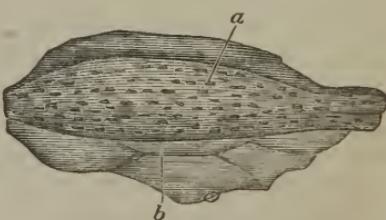


Fig. 45.*



* A nervous ganglion: *a*, internal structure; *b*, proper envelope.

lymphatic system, they are enveloped in an external covering, which is quite dense, and connected with the dura mater, in the spinal ganglia, but very thin and indistinct in those of the great sympathetic.

By boiling, the ganglia first harden, but subsequently they become soft and shreddy: the alkalies only partially dissolve them, and they resist putrifaction for a long while. Their vessels are derived from the neighboring branches, and can be readily filled with injecting matter. They are also rendered very apparent after inflammation. To this sketch of the ganglia it should be added, that those of the great sympathetic — to which the foregoing remarks are intended more particularly to apply — are all embedded in cellular substance, and that each of them may be viewed in the light of a small nervous centre, from which are detached filaments of communication to the encephalo-spinal nerves, and of distribution to the neighboring organs, bringing thus the nervous system into one harmonious whole.

The chemical composition of the nerves is analogous to that of the encephalo-spinal mass. By immersion in alcohol, they are readily hardened, and a long time elapses before they yield to the influence of putrifaction. They are extensible, but unelastic; void of irritability, but highly sensitive, — the pain which results from their injury being often sufficient to induce the most dreadful convulsions.

Every nerve is composed of two principal elements, which bear to each other the relations of contained and containing parts, (Fig. 46.) The first is of a soft, pulpy consistence, of white, yellowish color, and is made up of the same materials as the white texture of the brain, with the addition, perhaps, of a minute quantity of granular substance. Like the former, it consists of excessively delicate fibres, which are arranged in close parallel lines, and extend from one extremity of the nerve to the other, (Fig. 47.) Each filament is enclosed by a distinct sheath, which is firmly united to those around it by cellular texture. The number of fibres entering into the formation of any one nerve is not ascertained: some have only a few; whilst others, as, for example, the sensific portion of the fifth

Fig. 46.*



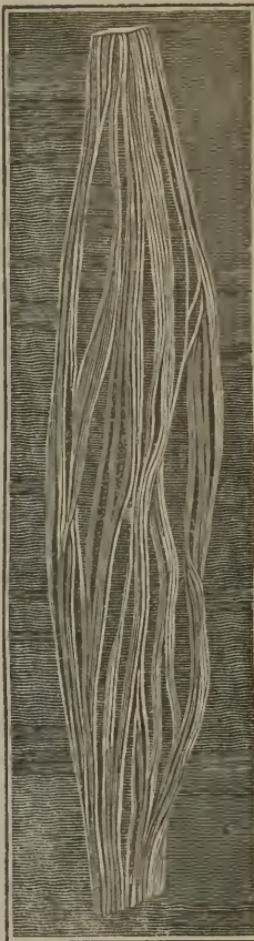
* A portion of nerve invested by its neurilemma, and consisting of distinct filaments, one of which is drawn out and transfixed by a pin.

pair of the cranium, have as many as sixty or eighty. When relaxed, many of the fibres have a convoluted, zigzag arrangement, which is particularly observable in some of the inferior animals, as the horse, ox, dog, and deer. Whether each filament is a solid cylinder, or a hollow tube, is not ascertained.

Thus constituted, each nerve has its appropriate envelope, as each fibril has its appropriate sheath. The nature of this investment has been a subject of much controversy; but, without stopping to inquire into the various opinions that have been advanced by authors, I will merely state that it appears to me to be distinctly fibrous in its structure, and consequently analogous to the coverings of the muscles. In its thickness, it varies in different regions of the body; and, in some of the nerves, as the olfactory and auditory, it is either entirely absent, or so attenuated as to render it impossible to demonstrate it. Externally it is connected to the surrounding parts by cellular tissue, whilst from its inner surface are detached numerous processes, that form so many small canals for the reception of the pulpy substance previously described. These sheaths can be rendered apparent by injecting them with quicksilver after their contents have been dissolved in some diluted alkali.

The nerves are liberally supplied with blood. The arteries are derived from the neighboring trunks, and, as they approach the neurilema, each subdivides into two branches, one of which pursues a forward, the other a retrograde direction. How the ultimate ramifications are spent it is impossible to say, though it is not unlikely, I think, that they all terminate in the sheath of the nervous fibrils, the latter having no par-

Fig. 47.*



* Nervous fibres deprived of their covering, and unraveled, showing their component filaments.

ticular connection with them. When the arteries are filled with size, colored with vermillion, the nerves exhibit a red florid appearance, and might be supposed to consist almost wholly of a tissue of vessels. The veins are numerous, and pursue, for the most part, a very tortuous course. As in the brain, no absorbents have yet been traced, excepting in the neurilema of a few of the larger trunks.

The nerves are liable to acute and chronic inflammation, suppuration, ulceration, gangrene, hypertrophy, atrophy, and different kinds of tumors.

When a nerve is cut across, restoration generally takes place in a short time by the adhesive process, the small cicatrice thus formed offering no obstacle to its functions. When a portion is removed, the divided extremities, in the course of twenty-four hours, become enlarged and vascular, and the surrounding cellular tissue, taking on inflammation, pours out coagulating lymph, which finally encloses and cements them together. After some time, varying according to the thickness of the nerve, and the distance between the divided ends, the matter thus effused is organized, assuming a whitish, gristly appearance, and the function of the organ is either partially or wholly re-established. Sensibility commonly returns more quickly than voluntary motion. Mr. Mayo found that the sentient nerves, when thus mutilated, generally began to regain their functions early in the third week, while the motor nerves did not recover any of their powers till after the fourth. It is proper here to observe, that, if the interval between the divided extremities is very great, as from one to two inches, the union is either extremely imperfect, being effected solely by condensed cellular tissue, or, what is more commonly the case, nature entirely fails in her efforts, and the function of the part is thus forever destroyed.

In *acute neuritis*, the nerves are of a bright reddish color, their capillary vessels, which run longitudinally, being united by thousands of transverse twigs, which, in the normal state, always elude our closest scrutiny. When the inflammation is very intense, the affected part generally assumes a dark violet tint, either uniformly diffused, or occurring in small patches, like so many ecchymoses. These changes are always most distinct in the neurilemous coat; but by degrees they extend to the interstitial cellular substance, which at the same time becomes distended with serous, bloody, or purulent fluid, the natural tendency of which is to separate the

filaments of the nerve, and give it a tumid aspect. As the disorder progresses, the affected part loses its peculiar texture, diminishes in strength and consistence, and resembles a cord of inflamed cellular substance rather than a nerve.

This disease, which seems to occur much more frequently in the sciatic and facial than in any of the other nerves, is characterized by the most torturing pain, augmented by pressure, and accompanied generally by a peculiar numbness of the affected part. The pain often occurs in paroxysms, observing a regular periodicity; and, after it has existed for some time, it usually becomes less violent, but more constant.

It would appear, from the researches of M. Gendrin, that inflammation of a nerve, when artificially induced, always has a tendency to excite inflammation in the organ to which it is distributed. Thus, inflammation of the fifth pair will produce ophthalmia; of the eighth pair, gastritis; but, what is remarkable, not pneumonitis. The reverse of this probably sometimes occurs, the inflammation being propagated from the organs to the nerves.

The anatomical characters of *chronic neuritis* are, increased vascularity and consistence of the affected part, with slight swelling and friability. The neurilemous coat is considerably indurated, the interstitial cellular substance is infiltrated with serous fluid, and the capillary vessels are often so much loaded as to exhibit a truly varicose aspect. This affection, which is much more common, I am disposed to think, than has been generally imagined by pathologists, is almost always attended with severe pain, and, like the acute form, may be confined either to a small portion of a nerve, or diffused over an extent of several inches.

Suppuration of the nerves has been noticed by different writers, though there is reason to believe that it is very rare. The matter, which is commonly of the character of healthy pus, is usually infiltrated into the interfibrillar cellular tissue, in which it appears to be originally developed, the nervous substance itself being little altered. Occasionally the pus lies immediately beneath the neurilemous coat, which it raises in the form of a little abscess. Bloody effusion was found by Martinet in the sciatic nerve of a man who had been affected with excruciating pain in the posterior part of the thigh, aggravated to almost absolute intolerance by the least motion; and Cotunni noticed, long ago, that serous infiltration is often connected with neuralgia.

Ulceration of the nerves is still more rare than suppuration. It never occurs spontaneously after inflammation, but is always dependent upon injury or disease of the adjacent structures. In a case of ulceration of the peroneal nerve, reported by Mr. Swan, of London, there was a fungous ulcer of the leg, with violent pain of the whole limb, which rendered it necessary to amputate.

Gangrene of the nerves, like ulceration, is generally complicated with lesion of the surrounding parts, being seldom, if ever, present as a primary affection. In whatever manner it may be induced, the nerves are of a dark brownish color, highly offensive, and converted into soft, pultaceous cords, entirely destitute of their natural characters. The parts immediately above and below the seat of the disorganization are of a reddish tint, swelled, and infiltrated with serous fluid, — phenomena indicative of inflammatory irritation.

Carcinoma seldom affects the nerves, at least, very few well-authenticated cases of this disease are to be found in the records of pathological anatomy. Marandel states that he has witnessed this in the external saphenous nerve; Dupuytren, in the posterior tibial; Lévéque-Lasource, in the trifacial; Martin, in the median; and I have myself seen it in the optic nerve.

The nerves are occasionally found in a state of *hypertrophy*. In chronic affections of the leg, nothing is more common than to see the subcutaneous nerves thickened and injected. In dissecting, not long ago, the left leg of a man, thirty years old, removed for caries of the tarsal bones, I found the posterior tibial nerve, nearly in its whole length, very much indurated, and at least three times as thick as usual, all its fibres being extremely distinct and well-defined. Similar appearances have been noticed by Gendrin, Martinet, and Swan. The ends of the nerves, after amputation, often become very large, and have their sensibility morbidly increased. Occasionally the hypertrophy, although strictly local, affects a considerable number of nerves simultaneously. Of this a remarkable instance is recorded in the London Medical and Physical Journal for 1826. It occurred in a cretin, thirty-three years old, whose body was examined by Dr. Schiffner, of Vienna. The inferior maxillary and facial nerves, together with the eighth pair, and almost all the spinal nerves, presented numerous swellings along their trunks and branches, many of which were as large as a full-grown pea. The nerves also,

like the blood-vessels, are large when the womb is exhausted during pregnancy, as has been satisfactorily shown by Home and Tiedemann; and the same phenomenon is frequently observed in subcutaneous and other tumors.

Atrophy of the nerves, a state the reverse of that which I have just described, generally arises from mechanical injury, or the pressure of a tumor; yet that it occasionally exists as a primary affection seems to be undeniable. Whenever an organ of sense is destroyed, the nerve leading to it wastes, usually by degrees, but sometimes with great rapidity. In such cases, the nerve assumes a peculiar buff-colored appearance, and often shrinks to less than one third its normal bulk, its pulpy substance being sometimes totally absorbed, so as to leave behind it nothing but the dense and indurated neurilema.

Small *tumors*, the anatomical characters of which seem to be variable, are sometimes developed in the nerves, the component threads of which they separate from each other like the ribs of a fan. They occur most commonly in the nerves of the upper extremity, especially in the radial and ulnar, and are generally attended with severe pain and numbness. The origin of these tumors is still involved in obscurity: in some instances, they are evidently connected with the nervous substance; whereas, in others, they arise, with equal certainty, from the neurilemous covering. In a case mentioned to me by Professor Parker, the tumor, which was about the size of a hen's egg, was developed in the centre of the ulnar nerve, the fibres of which it forced apart, and was of a compact solid texture, like fibro-cartilage. This, perhaps, is the most ordinary structure of all these swellings. In the case described by the celebrated Cheselden, it was of the hygromatous character, being composed of a dense cyst, filled with a transparent jelly-like fluid.* Their magnitude seldom exceeds a walnut; in most cases, indeed, they are not larger than a filbert or a peach-stone. After amputation, the ends of the divided nerves are sometimes expanded into white, semi-cartilaginous bulbs, which frequently become the seat of morbid sensibility and neuralgia.

Concerning the lesions of the ganglia, very little is known with any degree of certainty. That they are liable, like the nerves with which they are connected and of which they are a part, to inflammation and some of its more ordinary con-

* The Anatomy of the Human Body, p. 256. Boston, 1806.

sequences, would seem probable, from the similarity of their structure ; but what the resultant changes are, the present state of the science does not enable us to point out. Professor Lobstein,* of Strasburgh, has found the thoracic ganglia and the semi-lunar plexus repeatedly very much engorged with blood, and of a lively red color, from the effects, evidently, as he supposes, of inflammation ; and similar phenomena have been noticed by other observers. In the yellow fever which prevailed at Natchez, in the state of Mississippi, in 1823, disease of the thoracic and abdominal portion of the great sympathetic appears to have been exceedingly common. Of twenty subjects examined by my distinguished friend Dr. Cartwright, of that city, seventeen presented inflammation of the semi-lunar ganglia and their plexuses : their vessels were greatly loaded with blood.

A number of examples of considerable increase of bulk of the ganglia of the sympathetic, from the influence of chronic irritation, are recorded. The enlargement which has been known to exceed six or eight times the normal size, is met with chiefly in the cervical ganglia ; but, occasionally, it has been seen in those of the thorax and pelvis. A remarkable case of hypertrophy of these bodies, probably produced by chronic inflammation, has been published by Professor Cruveilhier, which he observed in a subject in the dissecting-room of the "Ecole Pratique," of Paris, and concerning the previous history of which nothing whatever could be learned. All the cervical ganglia of the left side were enormously enlarged, especially the middle, which was two inches and a half in length by one inch in thickness, (Fig. 48.) They were of a grayish white color, and of a very dense, compact consistence, creaking very sensibly under the knife. On further examination, they were found to

Fig. 48.



* Treatise on the Structure, Functions, and Diseases of the Human Sympathetic Nerve. Translated by Joseph Pancoast, M. D. of Philadelphia, 1831.

be of a fibrous structure, arrayed in such a manner as to form a great number of cells, filled with a sort of gelatinous substance. The component nervous filaments were in a state of complete atrophy, the only part that was left being their neurilematic covering. The nervous cords between the diseased ganglia, as well as those which passed off from them, were very much augmented in volume, of a pale grayish color, and abnormally firm in their consistence. Their color, which varied from bright florid to deep black, was so completely dyed into them as to defy ablution. The cardiac and pulmonary plexuses were also affected, but much less frequently and extensively than those of the other viscera. In connection with these morbid appearances there was generally more or less lesion of the cerebro-spinal axis, the duodenum, stomach, lung, or liver.* It is much to be regretted that Dr. Cartwright has not stated whether the nervous ganglia and plexuses, in the cases which he inspected, had undergone any change of consistence, or furnished any particular secretion, as this would have afforded us a much better opportunity of judging in regard to the existence of inflammation than the mere fact of their discoloration.

* American Medical Recorder, vol. ix. p. 37. January, 1826.

CHAPTER XII.

Of the Eye.

I. *Lesions of the Lacrymal Apparatus.* — Preliminary Observations. — Lacrymal Gland. — Ducts and Sac. — II. *Lesions of the Ball of the Eye.* — The Conjunctiva. — Pterygium. — Lacrymal Caruncle. — Acute Corneitis. — Ulceration and Ossification of the Cornea. — Fleshy Excrencences. — Alterations of Form. — Diseases of the Sclerotica. — Choroid Tunic. — The Retina. — Amaurosis. — Optic Nerve. — Membrane of Demours. — Hæmophthalmus. — Lesions of the Iris. — Alterations of the Pupil. — Capsule of the Crystalline Lens. — Liquor of Morgagni. — Varieties of Cataract. — Vitreous Humor. — Heterologous Formations.

SEVERAL structures enter into the formation of the eye, which are entirely different from those to be found in other organs. Altogether, it is a most complicated apparatus; and, as might be expected, the diseases to which it is subject are at once numerous and interesting. This renders it incumbent on us to consider them somewhat in detail; and, as being first in order, we shall begin with those of the lacrymal apparatus.

SECTION I.

Of the Lacrymal Apparatus.

THE reader need scarcely be reminded that the lacrymal apparatus consists of the lacrymal gland, the two ducts of that name, the lacrymal sac, and the nasal canal. All these passages are lined by a prolongation of the mucous membrane of the nose, which, on its arrival at the lids, invests their posterior surface, extends into the Meibomian follicles and the excretory tubes of the lacrymal gland, and is finally reflected over the ball of the eye, forming what is named the conjunctiva. This distribution should be carefully borne in mind, inasmuch as it enables us to account for the sympathy subsisting between the eye and the nose, and the facility with which disease is propagated from the one to the other.

The *lacrymal gland*, placed at the upper and outer part of the orbit, is of an elongated oval shape, of a light pink color, and about the size of a small almond. Minutely examined, it is found to be made of a large number of rounded granules, similar in their appearance to those of the parotid, which are united together by delicate cellular tissue. It receives a considerable amount of nervous and vascular endowment; and the fluid it secretes is conveyed by a series of small tubes, from five to eight in number, to the surface of the eye, near its outer angle.

This body, though so easily affected by mental emotions, does not seem to be very prone to disease. Richerand and Lawrence state that they have never seen it inflamed, and the testimony of Beer and Middlemore is nearly to the same effect. That the idiopathic form of this complaint, as it is termed, is extremely rare, no one can doubt; but that it occasionally exists, the experience of the profession fully attests. Resulting commonly from external injury, there is reason to believe that it occasionally succeeds to inflammation of the neighboring parts, especially of the conjunctiva; and the subjects of its attack are such chiefly as are predisposed to gouty and rheumatic affections.

Owing to its infrequent occurrence, the anatomical characters of inflammation of this body have not been minutely ascertained; but as far as our observation goes, they are similar to those of other glandular organs. In the early stage of the disorder, there is merely an augmented flow of tears, with slight uneasiness in the situation of the gland: as it progresses, however, the natural secretion diminishes, and the movements of the eye become constrained and painful. The vessels of the little body are engorged with blood, its substance assumes a deep reddish complexion, and the interlobular cellular tissue is infiltrated with serous fluid, the swelling from this source being sometimes quite considerable. When the inflammation is violent, it may terminate in suppuration, which, however, is extremely rare, — Mr. Guthrie, who has written ably on the eye, having met with only one instance of it in nearly twelve thousand patients. When matter forms, it usually points above the upper lid; occasionally, it escapes into the cellular tissue of the orbit, and gradually works its way out through a fistulous opening.

There is a *chronic* form of the disease, in which the gland often becomes hypertrophied, and acquires a firm, compact

texture, not unlike an indurated pancreas. The enlarged organ either remains stationary, or it passes into tedious and imperfect suppuration : the disease is most frequent in scrofulous children, and is seldom attended with much pain. Chronic inflammation sometimes produces atrophy of this gland. I once dissected an encephaloid eye, in which this body was reduced to the size of a small bean, its substance being indurated, and of a yellowish drab color. The subject of the disease was a child ten years of age.

The lacrymal gland is liable to *scirrhus*, forming a hard, elastic, lobulated mass, of the consistence of fibro-cartilage. Under these circumstances the organ is often much larger than a walnut, or even of the size of a hen's egg. Its substance is of a white grayish color, dense, crisp, and intersected by membranous bands, resembling the interior of an unripe pear. Small cysts are sometimes interspersed through the diseased mass, filled with a thin, glairy fluid, or with a firm, fatty, melliceric, or sebaceous matter. *Scirrhus* seldom occurs before the middle term of life ; the pain is severe and lancinating ; and there is more or less distortion of the eye, with dimness, and, in some instances, total loss of vision.

Serous cysts, containing a thin, limpid fluid, are sometimes found in the lacrymal gland. Although generally very small, they have been observed, in a few cases, as large as a hen's egg. That this disease is rare, may be inferred from the fact that few oculists have ever met with it. Professor Schmidt, of Vienna, to whom is due the merit of first describing it, relates only two examples of it ; and the celebrated Beer never saw it more than twice or three times. By some, these cysts have been supposed to be identical with hydatids ; but the more probable opinion is, that they are nothing but dilated excretory ducts ; and this conjecture certainly receives corroboration from the fact that these tumors are generally distended with a fluid possessing all the properties of the lacrymal secretion, being of a thin, watery consistence, and of a sharp, saltish taste.

It occasionally happens that one of the *excretory ducts* of the lacrymal gland becomes dilated near its terminal extremity, forming a circumscribed, elastic swelling, immediately behind the upper lid, towards the temporal side of the orbit. It is semi-transparent, unusually delicate, of an ovoidal shape, and often reaches the size of a pigeon's egg, though generally it does not exceed a hazelnut.

The *lacrymal ducts* are liable to inflammation, which sometimes ends in suppuration, at other times in the obliteration of their caliber. Similar lesions occur in the *nasal canal*. The obliteration here, however, is usually partial, existing in the form of a stricture. Though the nasal canal is scarcely three quarters of an inch in length, there are three points in its course at which stricture may be located, namely, at its junction with the lacrymal sac, at its middle, and at its entrance into the nostril. The disease is produced in the same way precisely as stricture of the urethra; that is to say, by inflammation of the lining membrane, accompanied with effusion of lymph into its substance, and into the subjacent cellular tissue. Permanent obstruction, either partial or general, may also be produced by inspissated mucus, and by fibrin poured upon the free surface of the membrane.

The diseases of the *lacrymal sac* do not require special notice, as they do not differ from those of other mucous textures. Suppuration often occurs here, and the matter, being unable to find its way down into the nose or up into the eye, is apt to escape through the skin, leaving a fistulous aperture, which it is always difficult to heal.

SECTION II.

Of the Ball of the Eye.

THE ball of the eye, situated in the anterior part of the orbit, is of an irregularly spherical figure, its antero-posterior diameter, which is not quite an inch, being about one line longer than the other. It is composed of a series of concentric membranes lying in close apposition with each other, and arranged so as to enclose the humors of the organ. These latter are three in number, — the aqueous, the crystalline, and the vitreous, their names being derived from their appearance. The membranes, usually called the tunics of the eye, are the conjunctiva, the cornea, the sclerotica, the choroid, the membrane of Jacob, the iris, and the retina; besides which are the capsules, as they are termed, of the different humors. The organ thus contains almost every variety of elementary tissue,

and hence the great frequency of its diseases, with the diversity of their progress and mode of termination.

The *conjunctiva* is a thin, mucous membrane, lining the posterior surface of the lids and the front of the ball of the eye, which it thus connects together. Near the inner angle it is folded upon itself, so as to form what is denominated the semi-lunar valve, and as it is prolonged into the lacrymal points, it may be considered as being directly continuous with the mucous membrane of the tear-bag and of the chambers of the nose. The conjunctiva is exceedingly delicate and transparent, devoid of follicles and villosities, loose and pale on the sclerotica, firm, and rose-colored on the lids. The membrane also covers the cornea, but its structure here is so much changed that it can no longer be recognized. At the margin of the lids, where it is continuous with the skin, it is reflected into the Meibomian follicles, — a number of narrow, whitish, tortuous glands, designed to secrete an unctuous fluid for lubricating the eye.

The connection between the conjunctiva and the sclerotica is established through the medium of a pretty thick layer of cellular tissue, which, from the character it plays in the diseases of the eye, deserves to be dignified with the appellation of the *ocular fascia*. When carefully dissected out, it is found to be semi-transparent, strong and elastic, disappearing gradually upon the posterior part of the ball. It is remarkably well developed in the horse and ox, and I have always succeeded in making it out distinctly in the human subject. Considered in reference to its functions, it is of the same use to the conjunctiva that the cellulo-fibrous tunic, so well described by Cruveilhier, is to the stomach and bowels. It is the exclusive seat, in most instances, of the vascularity which characterizes inflammation of the sclerotic portion of the conjunctiva, and of the effusions attending it, whether of serosity, of lymph, of blood, or of pus.

Acute *conjunctivitis* is announced by more or less redness, which usually begins at the palpebral portion of the membrane, and gradually extends to that over the sclerotica. The injection is at first arborescent; by and by it becomes capilliform, and, in certain cases, it is so close as to give the organ the appearance of being blood-shot. With this augmented redness, the membrane loses its natural polish, the temperature of the part is augmented, its sensibility is altered, and there is a suppression of the mucous as well as of the lacrymal secre-

tion. The discoloration now becomes more and more vivid and intense ; the conjunctiva assumes a villous aspect ; serosity is poured out into the cells of the ocular fascia ; the tears flow in great abundance ; and the mucous discharge is not only restored, but uncommonly copious. Blood is sometimes extravasated beneath the conjunctiva ; and occasionally there is a secretion of lymph, by which the margins of the lids are completely agglutinated. In violent cases, such as we have here described, the disease is frequently propagated to the other textures of the eyes, and the discoloration extends backwards to the posterior section of the sclerotica.

Acute conjunctivitis often passes into *suppuration*. The matter, which is at first merely puriform, becomes gradually purulent, thick, and of a yellowish straw-color. The quantity secreted is sometimes surprisingly great — much more so than in any other mucous membrane of equal extent — from four to eight drachms being discharged in the twenty-four hours. Like the matter of gonorrhœa, it is frequently of a highly acrid and irritating nature, and has the property, when applied to the sound eye, of engendering the same affection. Many surgeons have disbelieved this ; but the experiments of Guillé, Hupsch, Kirkhoff, and others — which consisted in inoculating different persons with matter taken from patients afflicted with ophthalmia — have affirmatively settled the point. The disease, when thus produced, usually appears in from one to three days.

There is a variety of this disease in which the effusion of serosity is so great, as to give the eye a truly *œdematous* aspect. The sclerotic portion of the conjunctiva is elevated into a soft, transparent tumor, forming a ring around the cornea, which appears deeply sunk in the back, and sometimes almost entirely concealed : the effusion often encroaches considerably upon the lids, which are thus rendered tumid and everted. Very little vascularity attends this variety of ophthalmia. In severe cases, the conjunctiva has been known to form a tumor as big as a walnut, from this cause.

In another series of cases, the mucous membrane is raised into small *vesicles*. Seated in the subjacent cellular tissue, they are produced by an effusion of serous fluid, and seldom exceed the size of a common pin-head : they are of a spherical shape, diaphanous, and are most frequent in that species of ophthalmia which affects the conjunctival covering of the cornea. Their number is sometimes considerable ; and, on bursting,

they leave an ulcer which it is often difficult to heal. This affection has been described by Gendrin, who states that it is of frequent occurrence, and indicative of mild inflammation.

The corneal portion of the conjunctiva is also liable to the formation of *pustules*. Occurring in persons of all ages, they are most frequently met with in children, and sometimes spread through whole families, being generally concomitant of small-pox, measles, and aphthous affections of the mouth. The pustules are usually situated near the margin of the cornea, are encircled by minute vessels, and appear like small dusky spots, of a pale reddish color, slightly elevated above the level of the surrounding surface. If the inflammation be allowed to go on, purulent matter is formed, their apex ulcerates, their contents are discharged, and a cavity is left, the edges of which are dense and opaque. The nature of these pustules is still unknown. The most plausible conjecture is, that they are the result of inflammation of the mucous follicles, which we have reason to believe exist in the conjunctiva, although they have not yet been demonstrated there.

Chronic, like acute inflammation, usually begins in the palpebral conjunctiva, and is often entirely confined to that part. The membrane, which is of a uniform reddish color, verging on purple, is thickened by an effusion of lymph, and converted into a dense, fleshy-looking substance. Its surface is always more or less rough; and, in many instances, it is studded with small, spherical bodies, improperly called *granulations*. These bodies, although they are generally dispersed over the whole surface of the lids, are always most luxuriant along their edges; and they seldom extend over the sclerotic and corneal portion of the membrane. Being of a soft, fleshy consistency, they are of a florid color, extremely vascular, highly sensitive, and liable to bleed on the slightest touch. Instances occur in which they are of the color and density of fibro-cartilage; and, occasionally, they resemble little clots of blood, being of a livid hue and of a fungous consistency. The magnitude which they attain, in cases of Egyptian and venereal ophthalmia, is sometimes surprisingly great. On the whole, it appears to me that these vegetations are nothing but enlarged villosities, with which the surface of this membrane, like every other of a similar kind, is naturally covered. Villosities have not, it is true, been demonstrated here in the sound state; but that they exist, in certain

pathological conditions, my own observations fully convince me.

If the inflammation recurs from time to time, or is unusually protracted, the vessels of the conjunctiva are apt to become permanently enlarged. The veins, especially, may be observed to be tortuous, of a dark color, and irregularly nodulated, like varicose veins in other parts of the body. Whether the arterial capillaries participate in the enlargement, I am unable to say; doubtlessly they do, in some instances. Added to all this, there is generally considerable thickening, with opacity and relaxation of the conjunctiva: the lacrymal caruncle is hypertrophied, as are also the Meibomian follicles, and the secretion from these structures is unnaturally thick and copious.

A new membrane occasionally forms on the conjunctiva, producing what is called a *pterygium*, and is most common in old people, though no age is exempt from it. It is generally of a flat, triangular shape, with the apex directed towards the pupil; has a fleshy look and consistence; and almost always grows at the internal angle, tending, in its progress, to encroach upon the cornea. Its vascularity is often quite great, the vessels running in a straight line, and presenting a varicose state, especially when of long standing. In most instances, the morbid growth is soft and movable; now and then, however, it is found firmly adherent, thick, coriaceous, hard, like parchment, or even cartilaginous. Mr. Wardrop mentions a case in which there were two pterygia on each eye.

The manner in which this membrane originates is still a matter of dispute. In most cases, it seems to consist simply in a hypertrophied state of the conjunctiva; but, occasionally, it is probably an entirely new formation, commencing in an effusion of plastic lymph. As it increases, it generally appropriates to itself a large supply of vessels, which thus nourish and support it.

As an effect of inflammation, the *lacrymal caruncle*, as it is called, is sometimes hypertrophied. This structure is naturally quite small; but, when thus affected, it often acquires the volume of a pea, or even of a cherry. It is generally of a pale reddish color, and of a soft fleshy consistence, with a rough tuberculated surface. Sometimes it is very dark, and almost black.

The *cornea* occupies the anterior sixth of the ball of the

eye, and is of a circular shape, — its transverse diameter, however, being a little longer than the vertical. Anteriorly, it is convex and covered by the conjunctiva; behind, it is concave, and lined by the membrane of Demours. The proper substance of the cornea is of a fibro-cartilaginous nature, transparent, dense, elastic, and made up of five or six concentric lamellæ, connected together by short, cellular tissue, the interstices of which are filled with a clear, unctuous liquid. No nerves have yet been traced into the interior of this membrane; and, in the sound state, it is perfectly insensible.* Its vessels, which are derived from the sclerotic coat, naturally carry a colorless fluid, and are therefore indiscernible.

The cornea, provided it be sound, readily unites when divided, the process by which this is affected being the same as in other parts of the body. If a portion be removed, it is never completely regenerated; but the chasm is filled up with an opaque substance, of a hard, cartilaginous consistence.

Although *acute corneitis* occasionally arises without any assignable cause, yet, in most instances, it is directly chargeable to external violence. In the early stage of the disease, there is scarcely any perceptible alteration in the part concerned, the only change being a slight degree of haziness. By and by, however, the membrane loses its transparency, assumes a bluish milky aspect, softens, and becomes distinctly vascular, — hundreds of vessels, extremely fine and delicate, running in every direction from the circumference towards the centre. In aggravated cases, blood is sometimes effused into the substance of the cornea, or the capillary injection is so great as to give the membrane the appearance of a piece of scarlet cloth. Very often a red zone is seen round the fore part of the sclerotic coat, formed by a wreath of vessels which freely anastomose with those of the cornea. The anterior surface of the membrane is occasionally quite rough; the movements of the eye are impeded, and there is deep-seated pain in the orbit, with intolerance of light; and, in the more violent grades, hemicrania. The conjunctiva is generally extensively implicated; and, in strumous habits, the inflammation frequently spreads to the iris, the choroid, and the retina, leading to great and permanent mischief.

* Professor Schlemm, of Berlin, it is true, asserts that he has succeeded in tracing nerves into the substance of the cornea; but his dissections have not, I believe, been verified by other anatomists. (See American Jour. Med. Science, Nov. 1830.)

Acute corneitis passes sometimes into *suppuration*. The matter collects either immediately beneath the conjunctival covering, or else between the lamellæ of the proper substance of the membrane, and generally appears in the form of a small abscess. This gradually increases in size, until it produces a considerable prominence, when it either bursts, or its contents are removed by absorption. The pus, which is usually very white and mixed with lymph, occasionally escapes into the anterior chamber. The parts immediately around the abscess are always more or less softened, vascular, and opaque.

In violent grades of inflammation, especially when occurring in persons of a strumous habit, the cornea sometimes loses its vitality, and is detached in grayish, dirty-looking eschars, leaving one or more openings through which the iris protrudes. Some anatomists have doubted whether the cornea is susceptible of this change; but the observations of Beclard, Saunders, Mirault, and others, have affirmatively settled the question. The change is most apt to take place in the pustules which form on the eye in cases of confluent small-pox.

In *chronic* corneitis, the membrane is opaque, of a grayish tint, condensed, indurated, and thickened, yet more easily torn than in the healthy state. Vessels may be traced over its anterior surface, which are much larger than in the acute form of the complaint, and their contents seem also of a darker hue. Little pain is present; objects are perceived indistinctly, every thing having a hazy appearance; and, if the cornea is incised, it is generally slow in uniting. There is now a patient in the Cincinnati Eye Infirmary, a young man thirty-five years of age, whose cornea Dr. Drake divided more than two weeks ago, and yet the adhesion is still very imperfect. Numerous vessels can be seen ramifying through its substance from the sclerotic coat: it is of a cineritious color, and there is a total absence of pain. In cases of very long standing, the thickening and opacity of the cornea are sometimes very great: the surrounding textures are deeply implicated, and the ball of the eye appears as if covered with a strong fascia, the fibres of which converge towards the centre of the cornea, and exhibit a yellowish pearly lustre, not unlike the inner surface of an oyster-shell. A deposit of lymph, produced, probably, by a slow chronic inflammation, is often seen around the cornea of old people, forming a regular

circle which has been denominated the senile arch. It has been observed, in a few instances, even in young children.

The cornea, like the other fibro-cartilages, is liable to *ulceration*; and this is a very common consequence of the bursting of an abscess; but it may also take place without any antecedent suppuration. A species of softening sometimes precedes this process, leading to the formation of an immense number of erosions, so exceedingly minute as almost to escape the naked eye: they are superficial, rough, irregular, and without any circumjacent vascularity. In the majority of cases, however, the ulceration presents a more decided character; it is deep, well-defined, and of a pale ash-color, with high, jagged edges; its surface is bathed with a thin acrid fluid; the part is extremely sensitive; and the sore manifests a strong tendency to spread in depth and diameter. In this manner the disease often progresses until the cornea gives way, and there is an escape of the aqueous humor, or, what is worse, a total destruction of the organ. In old people we sometimes meet with crescentic ulcers situated, near the circumference of the cornea, which, however, seldom reach to any great depth.

It is an interesting fact to know that ulcers of the cornea, whatever may be their form or extent, are susceptible of *cicatrization*. Frequently, after they have existed for a while, their progress seems to be suddenly arrested; the eye becomes less irritable; granulations sprout up; and the excavation is thus gradually filled up, the new texture assuming at length the properties of the lost substance. Most generally, however, the reproduction is imperfect,—the cicatrix which is left being opaque, and depressed in the centre, and thus vision is often materially impaired.

The lymph effused in inflammation sometimes remains unabsorbed, and gives rise to *opacity*. It occurs in every intermediate degree, from a slight haziness to entire loss of transparency, and may be either superficial or deep-seated, circumscribed or diffuse, punctiform or linear, circular or crescentic. In many cases, the opacity continues through life, the lymph upon which it depends becoming, no doubt, partially organized.

The cornea is liable to *ossification*. Wardrop saw a case in which the whole eye had changed its form, and the cornea contained a hard, smooth, oval plate of bone, weighing two grains. A piece of bone was also found between the choroid

coat and the retina of the same eye.* In another case, referred to by Voigtel, a German author,† a piece of cornea, taken from a man sixty years of age, was converted into osseous matter. It was three lines long, two broad, and weighed two grains. A still more remarkable example is reported by Dr. Monet, in the *Nouvelle Bibliotheque Medicale* for May, 1817. It occurred in an old man, and the cornea is said to have been ossified throughout. This transformation is by no means so frequent as the cartilaginous, of which a considerable number of instances are related by authors.

Fleshy excrescences have been seen on the cornea. They are occasionally of a fungous character, and in several instances they have been found to contain hairs. These morbid growths appear to have their origin, for the most part, on the conjunctival covering of the cornea.

Alterations in the *form* of the cornea occur under two principal varieties, the conical and the spherical, which, as they arise from different causes, require to be considered separately. The conical variety is sometimes congenital, or begins to appear soon after birth. More commonly, however, it does not come on until about the age puberty, and, what is very singular, it is said to be more frequent in females than in males,—for what reason is not known. The alteration generally advances slowly, and occasionally affects both eyes, though seldom in an equal degree. The cornea, which is at first only somewhat prominent, gradually assumes the conical shape, and has a peculiar sparkling, crystalline appearance, preventing the pupil and iris from being distinctly seen. After a while, small whitish specks are seen, which sometimes coalesce until the whole structure is rendered perfectly opaque. In some instances, ulceration sets in, and is eventually succeeded by a protrusion of the iris. The most extraordinary example of this variety of the disease is mentioned by a German author of the name of Brugman. He declares that both corneæ were so prodigiously elongated that they reached down to the mouth like two horns!‡ Both in this and in the next variety, the surface of the staphylomatous protrusion displays arborescent vessels, conveying red blood, and, where the tumor is large, acquires a cuticular incrustation.

* *Morbid Anatomy of the Eye*, vol. i. p. 74. Second edition. London, 1834.

† *Handbuch der Pathologischen Anatomie*, b. ii. p. 92. Halle, 1804.

‡ See Wardrop, *Op. cit.* p. 136.

In the other variety, which is the most common, and which usually follows the bursting of an abscess or ulceration, the cornea forms a whitish, pearl-colored projection, of a spherical figure, and often of considerable magnitude. The membrane is unequally thickened; its laminar arrangement destroyed; its texture generally more or less softened; and numerous vessels can be seen towards its circumference, and sometimes even towards its centre. In this variety the anterior chamber of the eye is annihilated; the iris is torn into radiated fragments; and vision is lost or impaired, according to the extent of the projection and the opacity of the membrane.

The late Professor Dupuytren, of Paris, a few years ago, described what he calls an *encysted tumor* of the cornea. He observed it in a child who had been struck on the eye a few weeks before with a stone. It grew between the lamellæ of the membrane, and was distended with a serous fluid, which was reproduced in a fortnight after it had been evacuated. This, I believe, is a solitary instance of such a tumor in such a situation.

The *sclerotic coat* is a strong, dense membrane, belonging to the same class of textures as the pericardium, the peritoneum, and the dura mater. It is opaque, of a dull whitish tint, consists of a single lamella, and is composed of firm, inelastic filaments so intimately interwoven as to render it impossible to unravel them. Behind, it is perforated by the optic nerve; and, in front, it has a large opening, which is occupied by the cornea. Externally it is convex, and covered with fine, cellular tissue, which connects it with the conjunctiva: its internal surface is smooth, glistening, and lies in apposition with the choroid.

The sclerotic coat has no sensibility in its natural state, and no nerves have been traced into it. The vessels which it receives are also few in number. A little behind the cornea it is pierced by the anterior ciliary arteries; and the posterior ciliary vessels pass through it, around the entrance of the optic nerve. The veins which form the *vasa vorticosa* of the choroid perforate it obliquely, about its middle.

The sclerotic coat, like the other fibrous textures, takes on inflammatory action with great reluctance; but, after having once set in, it is always obstinate, painful, and difficult of cure. The disease is generally confined to the anterior half of the membrane, is very apt to involve other parts of the eye, especially the conjunctiva, the cornea, and the iris, and

is most frequently observed in persons of a gouty and rheumatic predisposition, its favorite period of attack being the spring. It is characterized by deep-seated redness of the eye-ball, verging upon lilac, unaccompanied with thickening or opacity. The distended vessels form a beautiful zone about a line behind the cornea, whence they proceed backwards in a radiating direction, until they gradually lose themselves in the posterior part of the organ: they do not branch out like those of the conjunctiva, nor are they so movable under the folds of this membrane, — a circumstance which, together with the dull, aching, paroxysmal nature of the pain, may be considered as almost diagnostic of the disease. Coagulating lymph is rarely poured out by the sclerotic coat when inflamed, and it seldom, perhaps never, suppurates. In chronic cases, the redness is considerably diminished, the affected part is rendered preternaturally flaccid, and the whole eye-ball assumes a sickly yellow hue.

The sclerotic coat is sometimes remarkably thin and flaccid, so as to be incapable of maintaining the globular shape of the eye. This state is usually connected with disease of the other membranes, and with disorganization of the vitreous humor. On the other hand, the sclerotic coat is sometimes unnaturally indurated and thickened; and, in a few instances, it has even been found partially ossified. It occasionally becomes attenuated by interstitial absorption, and bulges out in the form of a staphylomatous protrusion. Wardrop mentions a case in which there were several little tumors of this kind, which felt soft to the touch, and were of a dark bluish color. Scarpa states that he once met with such a protrusion that was as large as a small nut; it was situated on the temporal side of the entrance of the optic nerve, and was of an oblong shape, the sclerotic coat being so thin at that part as to admit the light.

The *choroid coat* may be considered as a cellulo-vascular membrane, as it is essentially composed of arteries and veins, connected together by extremely delicate cellular substance. Nerves are also plentifully distributed upon this tunic; and its principal office appears to be that of secreting the black pigment which lies so abundantly upon its inner surface. Judging from its delicate organization, it might be inferred that the morbid changes of the choroid were extremely numerous and frequent, whereas quite the reverse is the case. The most important lesions to which it is subject are inflammation, dropsy, and ossification.

In inflammation of the choroid, there is little external redness, and the enlarged vessels which appear on the white of the eye are deep-seated, corresponding to the posterior ciliary arteries. When the disease is violent, suppuration may take place; and not unfrequently there is an absorption of the black pigment, or this substance is deposited in an altered and imperfect manner, or variously changed in color. The membrane is sometimes broken down in its texture, and its inner surface has been found coated with flakes of lymph. Varicose enlargement of the vessels occasionally attends this complaint; but this is a rare occurrence, and is seen only in cases of long standing. The disease is most commonly met with in strong, plethoric persons, is characterized by great intolerance of light, a contracted state of the pupil, and deep-seated pain darting through the head and temple.

Portal states that he has found hydatids between the choroid and retina; and accumulations of water have been noticed in the same situation by Zinn, Ware, Wardrop, and other writers. The fluid is generally thin and glairy, like white of egg; but sometimes it is watery, or of a pultaceous consistence.

Ossification of the choroid has been observed by Haller, Morgagni, Bichat, Scarpa, and other writers; the occurrence, however, I presume, is quite rare, and has hitherto been witnessed only in persons far advanced in life. Though for the most part partial, the transformation sometimes affects the whole membrane, converting it into a thin, osseous cup, perforated behind for the passage of the optic nerve. The disease has been supposed by some to have its seat in the membrane of Jacob,—an opinion which I am inclined to adopt from the fact that this tunic is of a serous texture, which, we know is particularly prone to this sort of transformation in almost every part of the body.

The *retina*, the most internal of the concentric tunics of the eye, lies between the vitreous humor and the membrane of Jacob, and is generally regarded by anatomists merely as the expansion of the optic nerve. Two distinct layers seem to enter into its composition, one of which, the external, is a very soft medullary looking texture, of the consistence of mucus, whereas the other forms a delicate vascular net-work, being made up mainly of vessels, derived from the central artery of the retina. In the living subject, this membrane is perfectly transparent, but, soon after death, generally in the course of ten or twelve hours, it becomes pale and opaque.

Observations are still wanting to enable us to give a complete history of the morbid anatomy of the retina. That this membrane is liable to inflammation cannot be doubted; but, as to the changes which it undergoes when thus affected, nothing satisfactory whatever is known. Wardrop informs us that he once saw it of a buffy color, produced, as he supposes, by an effusion of albumen; in another case, he found it quite opaque, tough, and thickened. Morgagni, Walter, and Magendie have witnessed similar examples. The latter writer relates an instance where the retina was converted into a white, firm, fibrous structure, in every respect analogous to an aponeurosis. Cases occur in which this membrane is partially atrophied, or even completely wasted, as in persons who have long been affected with amaurosis.

In *amaurosis* it not unfrequently happens that the vessels of the retina become enlarged and varicose. This change, as has been remarked by Mr. Wardrop, very probably takes place in those cases of the disease which are dependent upon cephalic congestion, and which are characterized by figures of various forms floating before the eyes. The disease may sometimes be relieved by depletion; but, in the generality of cases, there is reason to believe that it remains permanent and irremediable. Amaurosis, it may be here stated, often depends upon a deranged condition of the chylopoietic viscera, by correcting which, the patient speedily recovers his sight; in other cases, it is owing to disease of the optic nerve, or even of the brain; in others, it seems to arise from a palsied and disorganized state of the retina itself.

The *optic nerves* are liable to become diseased. In persons who have been long blind, it is not uncommon to find them very much wasted, altered in color, and changed in consistence, being either firm and fragile, or soft and pulpy. In some instances, the optic nerves are flattened, like pieces of tape, and of a yellowish, cineritious, or brownish hue. Occasionally they are the seat of calcareous concretions, of fibrous tumors, and of hydatids, though these affections are extremely rare, and I have never met with them.

There is a very singular structure, called the *membrane of Demours*, which furnishes the aqueous humor. It is extremely delicate, polished and transparent, and lines not only the posterior surface of the cornea, but the whole of the iris, terminating finally, as is supposed, on the capsule of the crystalline lens. No vessels can be seen in it in the natural

state, and many anatomists have altogether denied its existence. Like the serous tissue, which it closely resembles, the membrane of Demours is subject to particular morbid changes, a bare enumeration of which must suffice for our present purpose.

When this membrane is inflamed, constituting what has been termed *aquo-capsulitis*, it becomes more or less opaque, and its free surface is covered with globules of lymph, some of which are frequently detached, and float about in the anterior chamber, or form adhesions with the iris. The aqueous humor is at the same time rendered turbid, and is secreted in such abundance as to give the eye-ball an unusual degree of prominence. Besides these phenomena, the posterior surface of the cornea often presents several milk-like specks, environed by a sort of disk. The specks in question, give the membrane a singularly mottled appearance, and may be regarded as the characteristic marks of the disease. No capillary injection has ever been noticed, I believe, in this ophthalmia, though the vessels of the surrounding parts are often very much distended, especially those of the sclerotic coat, which sometimes form a beautiful zone just behind the cornea. Pus is occasionally poured out, but this is rare.

The lymph that is effused in this disease varies considerably in quantity. When there is only a little, it is generally absorbed ; in opposite cases, it frequently remains, and gradually becomes organized, red vessels passing through it in different directions. The form of the pupil is often remarkably altered by this substance, sometimes entirely closed up by it. The membrane of Demours is occasionally ossified ; and, in a few rare instances, small pieces of bone have been found in the anterior chamber.

The *aqueous humor* — the product of the membrane, the diseases of which have just been sketched — is sometimes altered, either in quantity or in quality. The fluid in the healthy eye does not exceed five drops ; in old people, it is considerably less ; and, in certain diseases, it is so much augmented as to constitute a real dropsy. The aqueous humor is sometimes quite acrid. Prochaska mentions a case in which it tarnished the extracting knife. The cellular hydatid has been repeatedly found in this fluid. Dr. MacKenzie gives not less than three cases of this kind, one of which came under his own observation.* In the horse, espe-

* Practical Treatise on the Diseases of the Eye. Second edition. London, 1835.

cially in India, it is sometimes inhabited by a worm, which, in size and color, resembles the common ascaris. The animal, which has received the name of *filaria papillosa*, is about an inch long, of a grayish color, equal in size to a sewing-thread.

The effusion of blood into the chambers of the eye from mechanical injury, is sufficiently common ; but its spontaneous occurrence in persons in other respects well, although sometimes observed, is extremely rare. The lesion is technically denominated *hæmophthalmus*. In some rare instances, the effusion seems to be vicarious of the menstrual function. Professor Walther, the celebrated German oculist, saw a case of this kind, in which the affection recurred regularly at the monthly period, and supplied the place of the suspended menses. An example, in some respects analogous, occurred some years ago in one of the Parisian hospitals, and is detailed in the fifth volume of the London Medical Gazette. In whatever manner this apoplexy be induced, it generally disappears completely, in from two to eight days, leaving the chambers of the eye perfectly clear, and vision unimpaired.

The *iris* is a thin, flat circular membrane, situated in the interior of the eye, between the cornea and the crystalline lens. Its external circumference is encased in the ciliary ligament, directly over against the margin of the sclerotic coat : the internal, which is free, is a little thinner than the other, and forms the border of the rounded aperture, denominated the pupil. Both surfaces of the membrane are flat ; the anterior has a downy, flocculent aspect, and is marked by a great number of striated lines : the posterior is contiguous to the ciliary processes, and besmeared with a dark bluish pigment, similar to that which covers the choroid. When this substance is washed away, two sets of fibres may be observed, one being radiated, the other circular, the latter being placed around the pupil like a real sphincter. These fibres are supposed to be muscular ; and they are lined, as was before intimated, by a reflection of the membrane of Demours.

The iris is abundantly supplied, both with vessels and with nerves, — the former being derived from the ophthalmic artery, the latter from the lenticular ganglion. The vessels approach the membrane in four different directions, and, anastomosing freely with each other, form two beautiful vascular circles, one around the outer, the other around the inner

margin of the iris. The veins pursue nearly the same course as the arteries, and terminate, for the most part, in the vorticosc veins of the choroid.

One of the most striking phenomena of *acute iritis*, is the vascular zone around the anterior margin of the sclerotic coat, formed by the minute ramifications of the ciliary arteries. This zone, which is not always complete, varies in distinctness, according to the intensity and duration of the disease. The vessels composing it seem to terminate abruptly at the circumference of the cornea, very few of them extending forward over its anterior surface or into its substance. The iris itself is discolored, dull, and thickened; the aqueous humor is more or less turbid; and the pupil is contracted, motionless, and irregular. Very frequently, perhaps most generally, the anterior surface of the iris is corrugated, slightly bulging, and covered with globules of lymph, of a whitish, yellowish, or reddish hue. Vessels and spots of blood are sometimes seen upon it; and, occasionally, especially in the more aggravated forms of the disease, the whole membrane has a brick-colored, ecchymosed appearance. Minute abscesses also sometimes form, break and discharge their contents into the anterior chamber. The quantity of effused lymph is often considerable, and either floats about in the aqueous humor, adheres to the surfaces of the iris, or fills up the pupil, and ties it firmly to the capsule of the crystalline lens. Great intolerance of light, deep-seated pain, lacrymation, and more or less constitutional disturbance are the ordinary attendants on this disease. Permanent adhesion of the iris to the lens, and lesion of the internal structures of the eye, are among the dangers which occur if the inflammation be permitted to progress.

There is a very slow, insidious form of iritis, which may be said to be *chronic* almost from the beginning. There is commonly very little redness, and the patient complains chiefly of dimness of vision, which is so gradually impaired that the sight is lost before he is aware of his misfortune. The most remarkable anatomical feature is the change of color of the iris, which is almost always of a singularly greenish cast; the membrane is also thickened, rough, and puckered, and the pupil is irregularly contracted, and fringed with lymph. The aqueous humor retains, for the most part, its natural aspect: there is little pain or intolerance of light; and the other structures of the eye are little or not at all af-

fected. This form of iritis is generally present when the membrane protrudes from ulceration of the cornea.

Prolapsion produces a slow change in the texture of the iris, rendering it unnaturally hard, and changing its form: a complete adhesion is often established between it and the cornea: in many cases, it is incrusted with partially organized lymph; and occasionally it assumes a granular appearance, and resembles a piece of flesh. Small tumors, of the nature of polypes, are sometimes found on the iris: they seldom acquire a large size, and are generally exceedingly vascular, bleeding on the slightest external injury, or even without any assignable cause.

The *pupil* is liable to various alterations, either congenital or acquired. Thus it has been found to be oval, rectangular, indented, slit-like, and even double; and, what is more remarkable than all, is, that these malformations are sometimes hereditary. Children are occasionally born without a pupil. This arises from the persistence usually of the pupillary membrane, which has been known, in a few instances, to continue until the tenth, fifteenth, and even thirtieth year of age. The changes produced by disease have been already incidentally noticed, and need not therefore be reenumerated.

The *capsule* of the crystalline lens is of a serous nature, belonging to the same class of membranes as the pleura and the peritonæum. It probably consists of a single lamella, the anterior segment of which is much thicker, denser, and stronger than the posterior. No nerves have been traced into its substance, and the only vessels that can be seen in it are a few small twigs from the central artery of the retina.

The first change produced in the capsule of the lens by inflammation, is a loss of transparency, arising from too great a fullness of its serous vessels. These vessels are arranged in the form of a wreath, composed of several distinct arches, situated about a fourth of a line from the pupillary margin of the iris. Running backwards from this wreath, in different directions, are numerous hair-like branches, which gradually lose themselves, at the circumference of the lens, in the iris, and the ciliary processes. From its excessive delicacy, this vascular arrangement can seldom be discerned without the aid of a magnifying-glass; and, occasionally, there is reason to believe that it is altogether wanting. Accompanying this injected state of the membrane is an effusion of lymph, which has always a tendency, when the disease involves the ante-

rior hemisphere of the capsule, to produce adhesions between it and the iris. At other times, the fluid is poured out in the form of small flakes, which float about in the chambers of the eye, where they are either gradually absorbed, or become attached to the surrounding parts. Occasionally the lymph connects itself at each side with the edge of the pupil, and shoots forward like a thin, narrow bar, which, in cases of long standing, has been known to have a cartilaginous, or even an osseous consistence. In regard to the membrane itself, its texture is always remarkably altered, becoming thick, tough, and of a white, opaque, milky appearance. Similar changes occur when the disease attacks the posterior segment, with the addition of much greater vascularity.

The inflammation of this membrane always observes a chronic course. It proceeds very slowly, and is attended with little or no pain. It is most common about the age of forty, and usually attacks subjects of a cachetic disposition, with light eyes. The iris, of a darker color than natural, is sluggish in its motions, and the pupil is contracted, irregular, and encircled by a black, narrow rim. When the disease has continued for a long time, the vessels of the capsule are apt to become permanently varicose. Pus sometimes forms, and cases occur in which the enclosed lens is completely dissolved.

Opacity of this structure forms a species of cataract, denominated *capsular*, a disease which is often congenital. As already hinted, it may affect either a part or the whole of the membrane; but, in the majority of instances, it is restricted to the anterior segment. The color of the cataract is very various. Sometimes it is of a dull milky appearance; sometimes white and glistening; sometimes mottled, grayish, yellowish, or brownish. Its texture also is very various, being at one time soft and pulpy, at another brittle and easily ruptured, at another tough and elastic, or of the thickness and consistence almost of the cornea. In people advanced in life, the capsule is sometimes ossified, either in part, or through its whole extent.

In the natural state, there is always found between the capsule and the lens a minute quantity of thin, pellucid fluid, which is called the *liquor of Morgagni*, from the illustrious anatomist who first detected it. This fluid occasionally becomes opaque, and thereby constitutes a species of cataract. It is also the seat, in some rare instances, of a species

of thread-worm, the ocular filaria of Nordmann.* In one of the cases narrated by this writer, the animal was three quarters of a line long, extremely narrow, and of uniform thickness, like the most slender thread. It was spirally convoluted, and had a simple intestinal tube, with a mouth, a uterus, and a prominent anal aperture. In another patient, an old female, Dr. Nordmann found the eye occupied with microscopical entozoa, possessing distinct suckers, and appertaining to the monostomastic genus of Rudolphi. The individuals, which were eight in number, were situated in the upper strata of the crystalline lens, were one tenth of a line in length, and moved sluggishly on being placed in tepid water. The substance of the lens was still soft, and retained a considerable degree of transparency.

The *crystalline lens*, situated at the junction of the anterior with the posterior two thirds of the eye, is embedded in a depression in front of the vitreous humor, being placed immediately behind the pupil, and surrounded by the ciliary processes. It is a doubly convex body, but the convexity is considerably greater behind than before: its diameter is about the third of an inch, and its thickness about two lines and a half. The shape, color, and consistence of the lens vary considerably in the different periods of life. In the foetus, it is nearly spherical, reddish, and very soft: in the adult, it is transparent, firm, and strictly lenticular; and, in old age, it becomes partially flattened, augments in density, but diminishes in bulk, and assumes a yellowish amber hue.

The substance of the lens is apparently of a homogeneous character, being soft and pulpy outwardly, but dense and firm within. When carefully examined, it is found to be composed of a series of concentric lamellæ, six or more in number, which are disposed similarly to the coats of an onion, and united together by fine cellular tissue, the whole being moistened by an interstitial serous fluid. No nerves or vessels have yet been traced into the substance of the lens; on which account some have imagined that it is not an organized structure. The very fact that it is susceptible of disease, is a sufficient refutation of this absurd notion.

It is extremely doubtful whether the crystalline lens is susceptible of acute inflammation; but that it is often affected chronically is abundantly established by the changes which

* *Mikrographische Beiträge zur Naturgeschichte der Wirbellosen Thiere: Erstes Heft*, p. 11—13.

it undergoes in its color, its shape, and its consistence. These changes generally occur slowly; and, taken together, they constitute an important class of disease, termed *lenticular cataract*. Existing either singly, or, as is more frequently the case, in combination with an altered condition of the investing membrane, lenticular cataract has been observed at all ages, but is most common, by far, in young children and in old persons. Infants are often born with it, and in many cases it is hereditary. Wardrop knew a father, son, and grandfather affected with it; and examples of a similar nature are recorded by different authors. Janson saw a whole family, consisting of six members, blind from this disease.

Age exerts a powerful influence in the production of cataract. The observations of Fabini and Maunoir clearly prove that the period of life most liable to this affection is between the sixtieth and seventieth years. In five hundred cases observed by the former, fourteen occurred between one and ten years, sixteen between eleven and twenty, eighteen between twenty-one and thirty, eighteen between thirty-one and forty, fifty-one between forty-one and fifty, one hundred and two between fifty-one and sixty, one hundred and seventy-two between sixty-one and seventy, and one hundred and nine after the latter period. In one hundred and twelve cases witnessed by Dr. Maunoir, eight occurred in persons under forty years of age, eleven between forty and forty-nine, twenty-five between fifty and fifty-nine, forty-one between sixty and sixty-nine, and twenty-seven between seventy and eighty-two.* Thus it would seem that more people are affected with cataract between the ages of sixty and seventy than at any other period of life. Children suffer comparatively seldom, though more frequently, perhaps, than youth. Sex does not appear to exert any particular influence in the production of this disease; but the male is certainly much oftener affected than the female, owing chiefly, if not wholly, to the former being more liable to all kinds of exposure.

This disease, as was previously intimated, generally proceeds slowly, so that vision is not destroyed for several years. Occasionally, however, the reverse obtains, the patient becoming blind in a very short time. Richter relates seven cases where people laboring under retrocedent gout were entirely

* Essai sur Quelques Points de l'Histoire de la Cataracte. Par Th. Maunoir, M. D. (Nevéu.) Mémoires de la Société Medicale d'Observation, t. i. p. 70. Paris, 1837.

deprived of their sight in a single night, from the formation of a cataract ; and Wardrop observed several instances where this occurred in a few hours. The disease may go on simultaneously in both eyes, but generally it begins in one, and in time attacks the other. Both sexes are equally subject to it. The starting point of the opacity is usually the centre of the lens, from whence it gradually extends towards its circumference.

The consistence of a lens in a state of opacity may be natural, augmented, or diminished. An increase of consistence is most common in persons advanced in life. After the sixtieth year, and occasionally even before that period, the cataract is frequently so hard that it cannot be divided by the needle ; and cases are not wanting in which it is completely ossified. A natural consistence is of rare occurrence, and is seldom seen except in young subjects, or in persons in whom the disease forms with extraordinary rapidity. A diminution of consistence is most common in childhood, and is sometimes very considerable, the lens being reduced to a thin milky fluid, or to a substance resembling half-boiled glue, arrow-root, or soft curds.

The color of a cataract is extremely various. In children, the opacity is generally white, like milk ; in older subjects, it is often of the hue of isinglass, a solution of starch, or half-boiled egg ; in aged persons, still darker, of a yellowish amber color, grayish, or brownish. A mottled appearance is not uncommon ; and, in some cases, though this is rare, the lens presents a radiated arrangement, the opaque lines converging towards the centre of the affected organ. It is important to remark that a diseased lens is seldom of the same color in the eye as it is out of it.

A change of form is of rare occurrence, and cannot be regarded as a necessary consequence of opacity. The volume of the affected lens may be natural, increased, or diminished. An augmentation of size is seldom observed, and then chiefly in cases of soft cataract. Atrophy of the lens is very common in old people, and often takes place without any accompanying opacity.

The *vitreous humor* is surrounded by the hyaloïd membrane, and lodged in appropriate cells formed by prolongations from its inner surface. Perfectly pellucid, it is heavier and more viscid than water, and is penetrated by a branch of the central artery of the retina. When evacuated, it is never

reproduced. The changes which this fluid undergoes have not been much studied, and we know therefore very little about them. It is sometimes unusually thick or thin, increased or diminished in quantity, and more or less altered in color. The capsule itself, being of the same structure as the membrane of the aqueous humor, is liable to the same morbid states. These, however, have not been observed with sufficient accuracy to admit of description. The membrane has been found ossified. Wardrop mentions several examples of the kind, and others are related by Morgagni and Scarpa.

We have thus taken the eye apart, as it were, and analyzed the diseases of its different structures. Considered as a whole, it is sometimes affected with atrophy, and the seat of various malignant growths. Of these, the most frequent and interesting are *encephaloïd* and *melanosis*.

Encephaloïd is a very common and fatal disease, which, although most frequent in children, is by no means confined to them, as has been intimated by some European writers. I have noticed it repeatedly in adults; and, lately, I saw my colleague, Professor Drake, extirpate an *encephaloïd* eye from a lady, forty-two years of age. In this case, as in many others, the disease was evidently excited by external violence. For a while, it grew very slowly; but, on reaching the sclerotica, it advanced with great rapidity, so as to acquire, in a few months, a very considerable magnitude. In October, 1837, when the patient was admitted into the Cincinnati Hospital, the eye was of a cylindrical shape, ulcerated, and of a dark, livid color, being the seat of repeated hemorrhages. It projected at least an inch and a half beyond the lids, but could still be moved by its own muscles, and did not appear to be attached to the socket. Her general health was rather infirm. In this condition, the organ was removed; and, on dissection, I observed the following appearances: the entire mass, after being divested of the muscles and cellulo-adipous tissue of the orbit, all of which were quite healthy, was nearly three inches in length by five and a quarter in circumference, its weight being a little upwards of two ounces. The eye itself was of the ordinary form and volume, but was considerably thrown out of its position by the morbid growth, which was of an irregularly oval shape, and sprung from the inner side of the sclerotica, near its junction with the cornea. This connection, however, was rather apparent than real;

for, on tracing the heterologous mass, it became evident that it originated in the retina, which had itself almost disappeared. The anterior surface was closely invested by the conjunctiva, which had a rough, fleecy aspect, from the morbid enlargement of its villosities: about its centre was an incrusted ulcer, about three fourths of an inch in diameter, around which the parts were somewhat knobby, and of a bluish livid color. On cutting through this portion of the tumor, it was found to consist essentially of vessels, some of which had been opened by the erosive process, and formed the source of the frequent hemorrhages with which the patient had been latterly affected. Posteriorly, the mass was of a much lighter complexion, as well as more soft, and exhibited that peculiar tuberoid arrangement so characteristic of encephaloïd.

The cornea, although still transparent, was considerably diminished in size, and adhered firmly to the iris. The sclerotica was of the natural thickness, extensively attached to the choroïd, and of a yellowish buff color. The choroïd itself was of a speckled, brownish appearance; at some points, it was completely disorganized; and, at one part, nearly opposite the morbid growth, there was a thin, black layer of blood beneath it. The retina, as before stated, was almost entirely destroyed; and, in place of the vitreous humor, there was a dense, solid, whitish mass, evidently the result of an effusion of fibrin. The anterior chamber of the eye was obliterated, and the iris transformed into a substance resembling fibrocartilage. The optic nerve, near its entrance into the sclerotica, was slightly enlarged, bulbous, and pervaded by encephaloïd matter.

In this case, I have no doubt the retina was the primary seat of the disease, and such, if we may credit the assertion of Scarpa, Saunders, Panizza, Wardrop, Lawrence, and others, is probably the fact in almost every instance. In this respect, therefore, the above dissection is one of much interest. The case is also important in another point of view, as it shows that this terrible disease may occur after the meridian of life, and in consequence of external injury. The rapidity with which it runs its course varies from a few months to several years: when extirpated, it *invariably* returns.

In regard to *melanosis* of the eye, I have no personal experience, but it would appear, from the dissections of Burns, Wardrop, Wilson, and others, that the disease generally originates deep in the organ; and that, if it do not commence

in the retina, it is closely connected with it. The optic nerve is frequently implicated, which is another proof that the heterologous growth may arise in the manner here stated. In a case recorded by Mr. Allan Burns, the cord within the cranium was as thick as the little finger, and as black as ink. The disease usually coexists with the same affection in other parts of the body, and has hitherto been noticed principally in persons above the middle age. Like encephaloïd, it gradually involves all the textures entering into the formation of the eye-ball, finally protrudes, and terminates in destructive ulceration.

CHAPTER XIII.

Of the Ear.

Preliminary Remarks.—Malformations of the external Ear.—Polypous Growths.—Lesions of the Tympanum.—Bones of the Ear.—Eustachian Tube.—The Labyrinth and Vestibule.—Diseases of the Auditory Nerve.

THE organ of hearing, situated partly within and partly on the outside of the skull, is usually divided into three portions—the external ear, the tympanum, and the labyrinth—which differ from each other widely, both as respects their structure, and the arrangement of their component parts. Almost every variety of tissue enters into the formation of this complicated apparatus; and hence its diseases are not only frequent in their occurrence, but also proportionably diversified in their nature. Much, however, as has been written concerning acoustic disorders, very little, it must be confessed, is known of their anatomical characters. Nor is this surprising, when we reflect upon the complicated structure of the auditory apparatus, the fact that many of its component parts are wholly out of the reach of ocular inspection, and the rare opportunities afforded for dissecting the organ in a state of derangement. All these are serious obstacles in the way of improvement, and we can therefore attempt little in respect to a scientific classification, in the present state of our knowledge.

The *external* ear, embracing the auricle and the auditory tube, affords a subject for pathological consideration chiefly on account of congenital malformation and polypous growths. The former of these is usually comprehended under the title of imperforation of the ear. It consists in the developement of a membrane, varying in extent and thickness, and either simple, or more or less complicated, with deficiency of the auricle and auditory canal. The commonest form in which it is presented is that of a single skin-like membrane, with a central indentation, corresponding with the entrance of the natural orifice: the depth at which the septum is situated

varies from half a line to the third of an inch: occasionally, indeed, it lies almost in contact with the tympanum. In more complicated cases, there is not only such a structure as that here mentioned, but there is great malformation of the outer ear generally.

Sometimes the outer ear is entirely wanting. The malformation is usually confined to one side, and is almost constantly connected with defective organization of the auditory passage. The hearing is not always lost when this state of parts exists. Oberteuffer has recorded an example of total absence of the auricles in an adult, who yet enjoyed this function very well. Professor Mussey, of Dartmouth College, has published the particulars of a somewhat similar case, in a late number of the American Journal of the Medical Sciences.* Another deviation from the normal standard is the congenital absence of the lobule of the ear, or its adhesion to the skin of the head. An anomaly of an opposite character is the enormous development of these parts.

The auditory canal, as was before stated, is sometimes imperforate: at other times it is very much diminished, and occasionally it is closed up by a dense, gristly substance, possessing all the properties of fibro-cartilage. Contraction of the canal may depend upon malformation of the temporal bone, or upon thickening of the soft parts, particularly the cuticle. Deviations in regard to the direction of this passage are now and then observed; but this, I presume, is extremely rare, and seldom exists singly. Sometimes its orifice is a mere slit instead of a round opening, and instances occasionally occur in which it is seriously encroached upon by the tragus, antitragus, and antihelix.

The lining membrane of the auditory tube is sometimes the seat of *polypes*. Soft and spongy in their consistence, they are of a pale reddish color, possess little sensibility, are very prone to bleed when injured, and seem to consist principally of a congeries of blood-vessels, connected by loose, cellular tissue, and enclosed by a thin delicate epithelium. As affecting the ear, they are generally of a conical shape, their attachment being by a narrow peduncle, whilst the body fills up the auditory passage, and sometimes projects a considerable distance beyond its orifice. Occasionally there are several such excrescences; and, in some instances, they have

* For February, 1838.

been known to be of the form, color, and consistence of a mulberry. Their progress is slow, and they may exist for a long time without destroying the function of the ear. When connected, as they often are, with the tympanic membrane, they are apt to produce permanent deafness. The exposed parts are commonly indurated, and of a whitish color, from the influence of the atmosphere. Polypous growths of the ear are always attended with an increase of the natural secretion, which is often fetid and acrimonious.

The *tympanum*, familiarly called the drum of the ear, is lodged in the base of the petrous portion of the temporal bone, being interposed between the auditory tube and the labyrinth, on which account it is not unusual for anatomists to speak of it as the middle ear. It is a narrow, irregularly cylindrical cavity, about three lines in length, and from five to six in breadth. Posteriorly, it receives the orifice leading to the mastoid cells, and, anteriorly, the opening of the Eustachian tube, whilst across its interior is stretched a chain of bones, the most delicate in the whole body. Throughout its entire extent, it is lined by a mucous membrane.

The most important part of the middle ear, in reference to pathological anatomy, is the tympanic membrane. This membrane is of a circular shape, oblique in its direction, slightly concave externally, and proportionably convex internally. Being extremely delicate and transparent, it is made up of three lamellæ, of which the inner is merely a reflection of the mucous lining of the middle ear; whereas the outer which is easily detached by maceration, is continuous with the cuticular covering of the auditory tube. The intermediate layer, that which gives the part its firmness and distinctive character, is of a fibrous structure, being composed of a great number of the most delicate filaments running like radii from the periphery towards the centre, where they are fixed to the long handle of the malleus. The vessels of the tympanic membrane are unusually abundant, and they resemble, in their mode of distribution, those of the iris.

Do wounds of the tympanic membrane ever *cicatrize*? Daily observation has long since answered this question affirmatively. Nor are there experiments wanting to illustrate the subject. The celebrated Valsalva repeatedly perforated, and even lacerated, this structure in dogs, which, after some time, he killed. In every one, the wounds were perfectly closed and cicatrized. Similar experiments have been performed by

other writers, followed invariably by similar results. Indeed, so fully are surgeons aware of this occurrence, that particular instruments have been devised for the purpose of preventing it. The period required for this reunion in the human subject varies from six to eighteen days, according to the size and shape of the opening, and the state of the membrane at the time of the operation.

Acute *tympanitis* is by no means unusual, and the rapidity of its course, as well as its mode of termination, is extremely variable. Generally only one ear suffers at a time, though it often happens both are affected simultaneously. The anatomical characters are increased opacity, and thickening, with perverted secretion. In mild cases, the redness is usually very slight, and only a few straggling vessels are to be seen; but when, on the other hand, the inflammation is intense, the affected part is of a scarlet hue, and the capillaries are so numerous as to present the appearance of a beautiful network. The normal transparency also is destroyed, and the part looks swollen and protuberant. Although lymph is seldom found upon the free surfaces of the membrane, yet in very severe cases it is not uncommon for this substance to be effused into its interlamellar structure. The ceruminous secretion is frequently suppressed, but the auricle and auditory tube remain unaltered.

This affection, which may affect either a part or the whole of the membrane, sometimes terminates in *suppuration*. The matter is rarely of a healthy character; on the contrary, it is usually muco-purulent, thin, and fetid, and so acrid as to erode the structures with which it comes in contact. Blood is occasionally blended with it,—the result, probably, in most instances, of exhalation. If the suppurative process be allowed to pursue its course unmolested, ulceration is super-added, which often continues until the membrane is seriously injured. The part of the membrane most liable to be thus affected is that immediately around the insertion of the handle of the malleus,—for what reason is not known. The number of ulcers is generally small: they are, for the most part, of an oval shape: they vary in size between that of a pin-head and a split pea; and in many instances they embrace the whole thickness of the affected part, leading to perforation and a discharge of the bones of the ear. No facts have yet been recorded, I believe, that go to show that ulcers in this situation ever cicatrize.

In *chronic* inflammation, although the vascularity is usually much less than in the acute form, the membrane exhibits every shade of red, from a pale rose to a mahogany brown. Striking alterations in the texture of the affected part are also observed. It is opaque, uneven, and thickened, so that the concavity of the membrane is effaced, and the insertion of the malleus can no longer be recognized even in the strongest light. Minute granulations are often seen upon the inflamed surface, varying in consistence, from the softness of recent lymph to the density of fibro-cartilage, and in color, from a pale ash to deep red: they are seldom bigger than a clover-seed, and are generally excessively sensitive, as well as vascular, giving rise to considerable pain and bleeding on the slightest touch. Small openings are frequently observed; added to which there is always a muco-purulent secretion, which is often discharged in great quantities, both externally and along the Eustachian tube. The matter is sometimes excessively offensive, particularly in scrofulous subjects, and of a greenish yellow color. In other cases, it is thin and glairy, like the white of eggs, and exhales a disagreeable ammoniacal odor. When the inflammation continues very long, the tympanic membrane, provided it is not wholly destroyed, not only becomes opaque and thickened, but acquires a dense, fibro-cartilaginous consistence. Examples of this kind, indeed, are not uncommon.

In severe cases of this disease, it is not uncommon for the cellular tissue and periosteum of the middle ear to become involved. A destruction of the tympanic membrane, together with a discharge of the small bones, is the usual consequence of this state. In addition to all this, there is generally extensive suppuration; the middle ear, the labyrinth, and the mastoid cells are filled with acrid pus; the petrous portion of the temporal bone is carious; the adjacent part of the dura mater is thickened, discolored, and partially detached; and the brain is softened and otherwise disordered.

Pus, chalky, and tubercular matter are sometimes found in the cavity of the tympanum; and Morgagni observed a case in which it was intersected by delicate membranous bands,—the result, probably, of former inflammation. Itard saw it filled with thick, yellow lymph; and, in one instance, he noticed a thin, watery fluid enclosed in distinct cells. Rosenthal witnessed similar appearances in the tympanum of a deaf mute.

The little *bones* of the ear may be wanting as a congenital defect, or as the result of ulcerative action of the tympanic membrane. It is seldom that they are all absent, yet several such cases are on record. In a deaf child, three years of age, Bailly found the ossicles of only one third their proper size. On the other hand, Cotunnius once found them twice as large as natural: the foramen rotundum was obstructed, and the labyrinth otherwise diseased.

Communicating with the tympanum is the *Eustachian tube*, — a passage leading obliquely forwards, inwards, and downwards, to the fauces, by the mucous covering of which it is lined. It is about two inches in length, by a line and a half in diameter, and is made up of three parts, — the posterior being osseous, the middle fibro-cartilaginous, and the anterior membranous. The lesions of the Eustachian tube may be thus stated: 1. congenital imperforation; 2. acute and chronic inflammation, with induration and thickening of the lining membrane; 3. partial stricture; 4. the presence of chalky matter; 5. mucous obstructions. Similar lesions occur in the mastoid cells.

The *labyrinth* is decidedly the most intricate structure in the body, and is therefore every way deserving of its name. It lies between the tympanum and the internal auditory hole, and consists of three compartments, — one of them being denominated the vestibule, the other the semi-circular canals, and the third the cochlea. Of the diseases of these chambers very little is known; it is certain, however, that they are infrequent, and that their anatomical characters have hitherto been very little studied.

Nature may leave the structure of the labyrinth imperfect, or it may, so to speak, wholly neglect its organization. In a case mentioned by Saissy, although the ear was well formed, the essential part of the auditory apparatus was entirely absent, there being no trace whatever of the vestibule, cochlea, or semicircular canals. The small bones were found, and the cavity of the tympanum was filled with a mucilaginous fluid. The Eustachian tube presented nothing unusual. The labyrinth is sometimes imperfectly ossified, exposing thereby a portion of its membranous structure; and cases are occasionally observed, though this is very rare, in which it is composed of a single cavity, closed naturally, and having no communication with the tympanum. Malformations of this kind are analogous to what externally occurs in the organ of hearing in crustaceous animals.

The *vestibule*, as well as the rest of the labyrinth, is occasionally filled with a substance resembling cheese. Dr. Haighton and Mr. Cline, of London, each met with an interesting case of this sort, attended with congenital deafness. Itard found the vestibule occupied with calcareous matter. Duverney states that he has often seen the labyrinth filled with thick, purulent fluid. This appearance is most common in the case of young children, and in nearly every case is connected with disease of the cavity of the tympanum.

Another malformation of this portion of the auditory apparatus is that of the round and oval apertures. These openings are not only unusually small in some instances, but even entirely wanting. The membranes closing them may also be diseased. Long-continued irritation has a tendency to render them thick, hard, and dry; and several cases are now on record in which they were completely ossified. We have already seen that the Cotunnian liquor is liable to degenerate into substances not naturally contained in the internal ear.

Of the diseases of the *auditory nerve* we are totally ignorant. That it is liable to be variously affected there can be no doubt; and that deafness, partial or complete, may be thus induced appears equally certain. The nerve is sometimes unnaturally small, soft, or hard.

EXPLANATION OF PLATES.

PLATE I. TUBERCLE.

Fig. 1; a portion of lung containing *miliary tubercles*. Page 155.

Fig 2; an *encysted tubercle*, in which the tuberculous matter is contained in a cyst, usually of a fibrous nature. Page 156.

Fig. 3; a portion of lung in which the tuberculous matter is *infiltrated* through the substance of the organ. Page 157.

Fig. 4; *stratiform tubercle*. This, next to the miliary, is the most common variety, and is generally situated on a serous or mucous membrane. Page 157.

PLATE II. MELANOSIS.

Fig. 1; a melanotic tumor, formed by the union of several small ones. Page 171.

Fig. 2; a portion of lung with *pedunculated* melanotic tumors attached to the pleura. Page 172.

Fig. 3; *lamellated* variety, which is deposited exclusively beneath serous membranes. Page 172.

Fig. 4; a portion of lung in which the melanotic tumor assumes the *dot-like* appearance. Page 172.

Fig. 5; the same, in which the dots are so close as to resemble infiltration. Page 173.

PLATE III. SCIRRUS.

Fig. 1; section of a scirrhus tumor. Page 176.

Fig. 2; laminated variety. Page 176.

Fig. 3; mammary sarcoma. Page 178.

Fig. 4; pancreatic sarcoma. Page 178.

Fig. 5; lardaceous scirrhus. Page 178.

Fig. 6; gelatinoid scirrhus. Page 178.

Fig. 7; fibrous scirrhus. Page 178.

PLATE IV. ENCEPHALOID.

Fig. 1; lobulated, or tuberoïd variety. Page 186.

Fig. 2; a pedunculated encephaloïd tumor hanging from a serous membrane. Page 187.

Fig. 3; a portion of lung, the morbid deposit assuming a stratiform character. Page 187.

Fig. 4; encephaloïd matter infiltrated into the cellular substance. Page 188.

Fig. 1.



Fig. 3.



Fig. 2.



Fig. 4.



Fig. 3.



Fig. 1.



Fig. 3.



Fig. 2



Fig. 1.



Fig. 5.

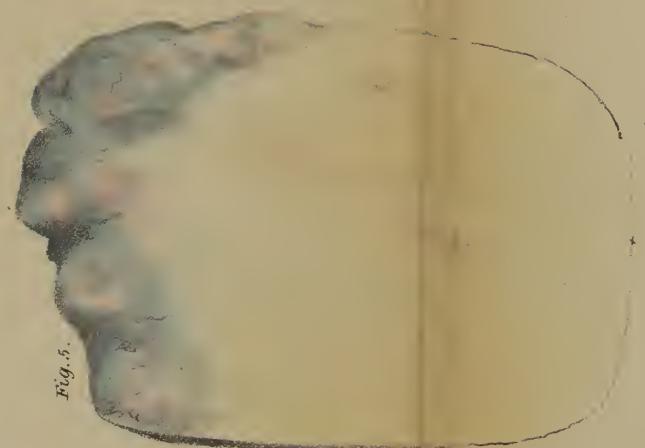


Fig. 3.



Fig. 6.

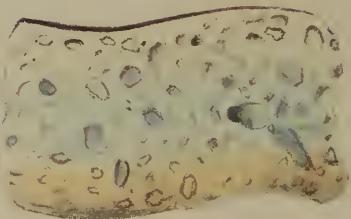


Fig. 7.



Fig. 4.





